SANDAKANIA 20 (2015): 51–85

Begonia (Begoniaceae) in the Danum Valley Conservation Area, Sabah, Borneo, including Eleven New Species

Chong Fung Yun[1], Veronica Samion Guanih[2], Julia Sang[3] & Ruth Kiew[4]

[1,2] Forest Research Centre,
Sabah Forest Department,
Sepilok, Sabah, Malaysia.
e-mail:
[1] rebecca.chong@sabah.gov.my
[2] veronica.guanih@sabah.gov.my

[3] Botanical Research Centre, Sarawak Forestry,
Kuching, Sarawak, Malaysia.
e-mail: juliasang@sarawakforestry.com

[4] Forest Research Institute Malaysia,
Kepong, Selangor, Malaysia.
e-mail: ruth@frim.gov.my

Summary. The Danum Valley Conservation Area (DVCA) lies in a tropical rainforest and harbours a diverse begonia flora. Based on a field survey, 15 species of *Begonia* are described and illustrated and a key for their identification is provided. Twelve are new species, *B. bernadusii* V.S. Guanih, *B. danumensis* F.Y. Chong, *B. dimorpha* S. Julia, *B. incompta* Kiew, *B. inopinata* V.S. Guanih, *B. inostegioides* F.Y. Chong, *B. prasinimarginata* S. Julia, *B. rotundibracteata* Kiew, *B. ruthiae* S. Julia, *B. taniana* V.S. Guanih, and *B. vespipropinqua* F.Y. Chong and one remains un-named due to lack of mature flowers and fruit. Two species, *B. bernadusii* and *B. vespipropinqua* belong to section *Baryandra*, the remainder to section *Petermannia*. All are endemic to Sabah and 12 are endemic to DVCA with only *B. gomantongensis* Kiew, *B. gueritziana* Gibbs and *B. postarii* Kiew recorded outside DVCA. The DVCA is a totally protected area having been gazetted as Class I Protection Forest. Therefore, the conservation status of 14 species is assessed as Least Concern and the one that is still incompletely known is assessed as Data Deficient.

The Danum Valley Conservation Area (DVCA) in SE Sabah, Malaysian Borneo, lies 65 km from Lahad Datu, the nearest town (Fig. 1). Under the jurisdiction of the Sabah Foundation, it covers 438 sq km of rainforest. It was first recommended as a permanent conservation area following the 1976 WWF-Malaysia Survey. It was gazetted in 1981 and in 1986 the Danum Valley Field Centre (DVFC) opened, subsequently in 1995, the area was declared as Class I Protection Forest (Hazebroek *et al*., 2012).

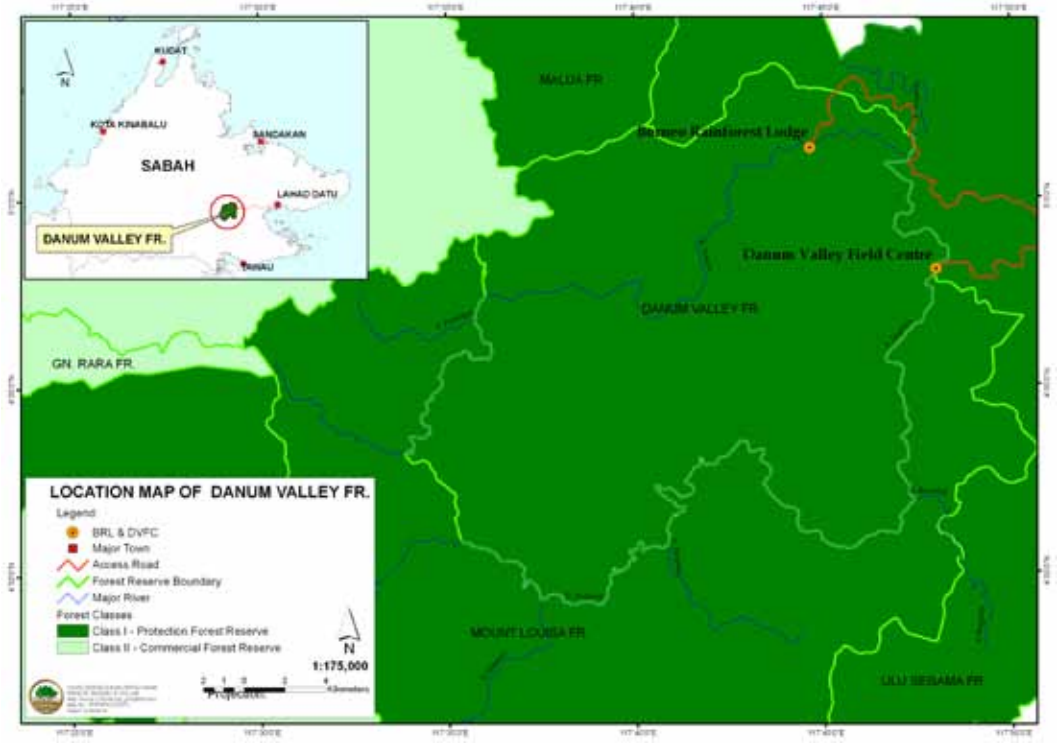

Fig. 1. Location map of Danum Valley Conservation Area.

The area has been well collected from the first 1976 survey, where the unpublished botanical report by Stone and Cockburn (Hazebroek *et al*., 2012) reported the presence of at least three un-named species of begonia. Since then botanists from the Sandakan Herbarium (L. Madani, A. Berhaman, S. Diwol, J. Sugau, M. Postar, S. Suzana), the Royal Society (G. Argent, E. Campbell-Gasis, C.A. Ridsdale), the Royal Botanic Gardens, Kew (S. Andrews, R. de Kok) among others have all collected herbarium specimens.

The impetus to investigate the Danum begonias in detail came from the 'Guide to Begonias of Borneo Project' that showed that in Sabah, the number of begonias described from lowland

mixed dipterocarp forest was grossly under represented. At present, of the 43 species listed for Sabah in the Southeast Asian Begonia Database (Hughes & Pullan, 2007), 17 species have been described from limestone, 15 from the Kinabalu National Park and only 11 species for all other areas in Sabah. To fill this gap, DVCA was chosen because an initial herbarium search in the *Begonia* collection in the herbarium of the Sabah Forest Department (SAN) revealed it was biodiverse for *Begonia* compared with other areas. However, many of the specimens are incomplete (without male and female flowers and fruits) and field notes for the colour of leaves and flowers and details of habitat were often lacking.

Materials and Methods

Based on herbarium specimens, the trails where begonias had previously been collected were mapped and the itinerary planned to re-collect as many species as possible to make complete herbarium specimens (with spirit specimens for flowers) and a photographic record. The survey was carried out on 26–28 July 2014 and covered the following trails: Danum Valley Field Centre (DVFC) — East Trail, Nature Trail, Riverine Trail and West Trail; Borneo Rainforest Lodge (BRL) — Belian Trail, Coffin Trail, East Trail, Jacuzzi Trail, Serpent Trail, Sapa Bebandil Trail, Segama Trail and East Trail. This enabled us to assess the commonness or rarity of the species and details of their habitat. Conservation assessments follow standard IUCN procedures (IUCN, 2001).

Results

Fifteen species were collected of which three species belong to known species, *Begonia gomantongensis* Kiew (2001: 259), *B. gueritziana* Gibbs (1914: 82), and *B. postarii* Kiew (1998: 164). Of the remaining 12 species, 11 are new species described below with the remaining one incompletely known because plants with flowers and fruits could not be found.

KEY TO SPECIES IN THE DANUM VALLEY CONSERVATION AREA (DVCA)

1. Rhizomatous begonia 2
   Erect or cane begonia 4

2. Rhizome less than 1 cm thick ..... *B. gueritziana*
   Rhizome at least 1 cm thick 3

3. Lamina glabrous, margin crenate ..... *B. bernardusii*
   Undersurface of lamina and petiole hairy, margin scalloped between veins and minutely dentate ..... *B. vespipropinqua*

4. Leaves not oblique (petiole in line with the midrib) 5
   Leaves oblique (midrib at an angle to the petiole) 8

5. Upper leaf surface with hairs 6
   Upper leaf surface glabrous 7

6. Lamina with a row of bristly hairs between the veins on the upper surface .... *B. danumensis*
   Lamina hairy on both surfaces ..... *Begonia* sp. 1 (incompletely known)

7. Internodes to 4 cm long. Bracteoles rotund, foliose, 6–9 × 4–9 mm ..... *B. rotundibracteata*
   Internodes 4–8 cm long. Bracteoles lanceolate, *c*. 6 × 2 mm ..... *B. incompta*

8. Lamina hairy above 9
   Lamina glabrous above 10

9. Low begonia, less than 10 cm tall. Leaves strongly bullate, hairs on upper surface raised on a conical base ..... *B. ruthiae*
   Stem at least 20 cm tall at flowering. Leaves not bullate, hairs without a conical base .... *B. postarii*

10. Low begonia, erect apex to 8 cm tall. Petiole 0.8–1.4 cm, lamina with a silvery pale green border 6–9 mm wide (visible on dried specimens as a paler border) .... 10. *B. prasinimarginata*
    Erect begonias, stem 20 cm or taller. Petiole more than 2 cm long, lamina plain green 11

11. Petioles 6.5–18 cm long. Surface of the ovary and fruit locules distinctly verruculose (pimply) ..... 4. *B. gomantongensis*
    Petioles 1.7–8.5 cm long. Surface of the ovary and fruit locule surface smooth 12

12. Petiole densely hispid. Inflorescences 10–16 cm long. Male flowers with 4 elliptic tepals 4–5 × 2–3 mm ..... 7. *B. inopinata*
    Petiole glabrous. Inflorescences to 4 cm long. Male flowers with 2 rotund tepals 3.5–5 × 3–5 mm 13

13. Stem to 21 cm tall. Inflorescences *c*. 0.7 cm long ..... 13. *B. taniana*
    Stem 25–117 cm tall. Inflorescences 3.8–2.5 cm long 14

14. Stipules *c*. 7 × 1 mm. Fruit oblong, 2 × 0.9 cm, pedicel stiff, *c*. 5 mm long .... 8. *B. inostegioides*
    Stipules 16–21 × 5–10 mm. Fruit broadly triangular in outline, 1.7–1.9 × 2.9–3 cm, dangling on a thread-like pedicel, 20–33 mm long ..... 3. *B. dimorpha*

1. Begonia bernadusii V.S. Guanih **sp. nov. (**Section *Baryandra*)

Among the rhizomatous begonia species in Borneo, *Begonia bernadusii* most resembles *B. gueritziana* in size and habit, but it is different in its larger leaves with petioles 14.5–24.5 cm long and lamina 8.5–12 × 12.7–15.5 cm (vs. with petioles 6–13 cm long and lamina 5–8 × 5.5–7 cm as in *B. gueritziana*), basal lobe 2–3 cm long (vs. 0.3–1.8 cm long) and wider outer tepals in the male flowers 12–14 mm (vs. 5–8 mm). Type: *Chong et al. SAN 156808*, Borneo, Sabah, Lahad Datu, Danum Valley Conservation Area, Garden next to the canteen of the Field Station, 26 July 2014 (holotype SAN!; isotype KEP!). **(Fig. 2)**

Rosette, rhizomotous begonia. Rhizome 12–15 mm diameter, succulent, pale greenish brown, glabrous, unbranched, internodes *c*. 1.8 cm long. Stipules light green, glabrous, lanceolate, *c*. 15 × 3–8 mm, margin entire, apex acute, persistent. Leaves alternate, oblique, distant; petiole pinkish green, glabrous, 14.5–24.5 cm long, terete, succulent; lamina pale plain yellowish green, glabrous, fleshy in life, matt, broadly ovate, asymmetric, 8.5–12 × 12.7–15.5 cm, broad side 7–10.2 cm wide, basal lobe rounded, 2–3 cm long, margin crenate, apex acute; venation palmate with 3 pairs at base branched three times and with 5 veins in the basal lobe, veins concolourous, impressed above, slightly prominent beneath. Inflorescences protandrous, axillary, cymose, greenish red, glabrous, erect, longer than petioles, 15–26 cm long, peduncle 13.5–23 cm long, branches 2, *c*. 3 cm long with 3 male flowers and 1 female flower. Bracts caducous; bracteoles pale green, boat-shaped, 4–7 mm long, glabrous, margin entire, persistent. Male flowers: pedicel *c*. 5 mm long; tepals 4, outer 2 tepals pale pink, glabrous, rounded, 10–12 × 12–14 mm, margin entire; inner 2 tepals white, narrowly obovate, glabrous, *c*. 8 × 3.5–4 mm, margin entire, apex rounded; stamens *c*. 30, cluster globose, shortly stalked; filaments yellow, 1–1.2 mm long; anthers golden yellow, obovate, 1–1.2 × 0.8 mm, apex rotund. Female flower (immature): pedicel *c*. 6 mm long, pale green, glabrous; ovary pale green, wings 4, 3 wings equal and 1 wing larger, locules (not seen); tepals (not seen); styles 3, pale yellow, *c*. 2 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Fruits not seen.

ETYMOLOGY. Named after Bernadus Bala Ola, principal botanist and naturalist, SEA Rainforest Research Programme, DVFC, in recognition of his keen interest in begonias and his knowledge of DVCA having worked at DVFC for almost 30 years.

ECOLOGY. Planted in soil sheltered under an overhanging rock.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu). From a plant originally collected by Bernadus Bala Ola from DVCA and presently cultivated in the small garden at the Field Centre.

SPECIMEN EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Conservation Area, Garden next to the canteen of the Field Station, *Chong et al. SAN 156808* (holotype SAN!; isotype KEP!).

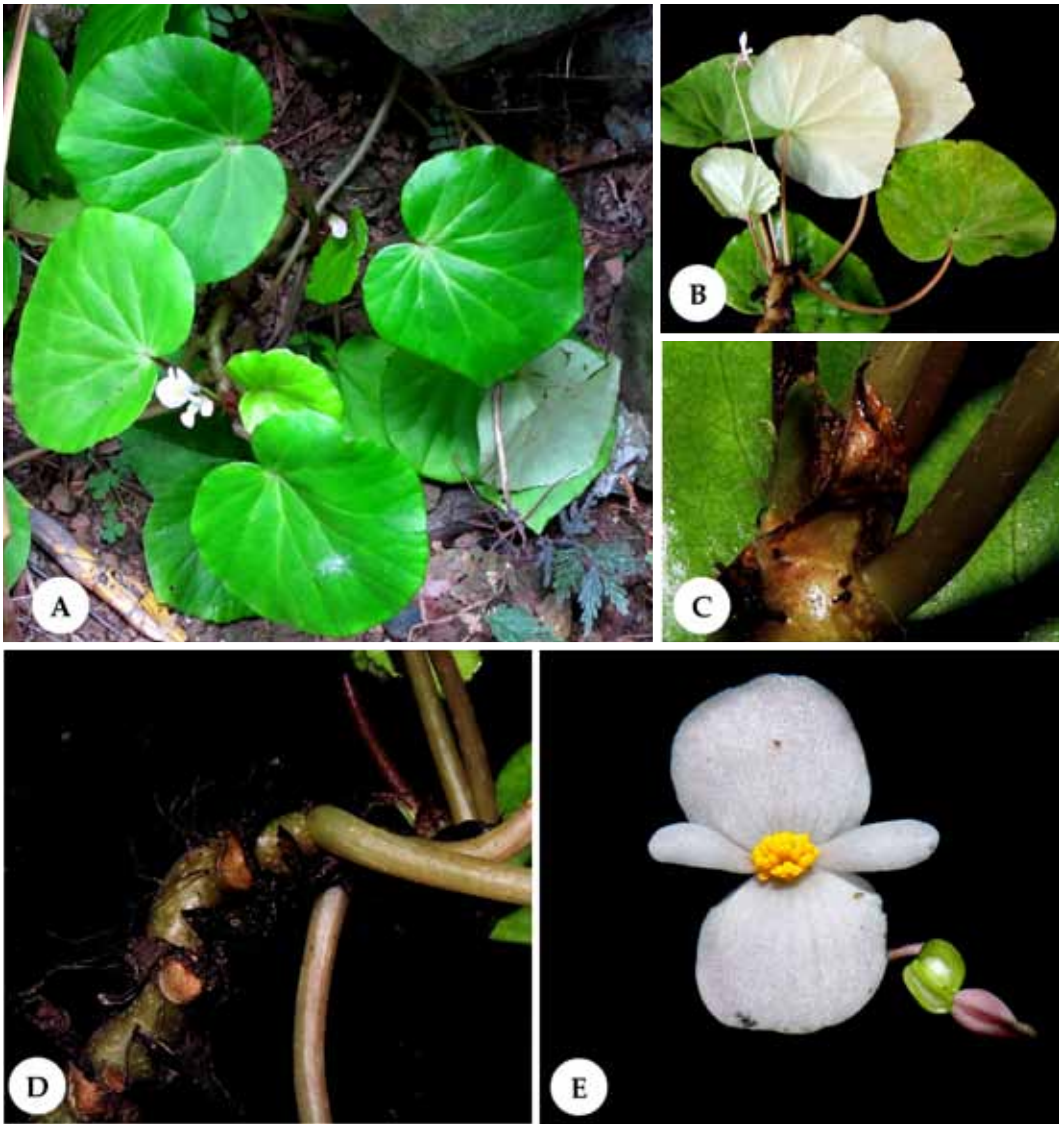

Fig. 2. *Begonia bernadusii*. **A** & **B.** Habit; **C.** Stipule; **D.** Rhizomatous stem; **E.** Opened male flower and unopened female flower. All photos from *SAN 156808* by Julia Sang.

NOTES. The original locality and habitat are not recorded, nor are there specimens in SAN. Only one plant was in flower. This showed that the inflorescence is protandrous and has boat-shaped bracts that place it in section *Baryandra*. However, the female flower was immature, so characters of the tepals and interior of the ovary could not be seen. The fourth 'wing' on the ovary is a thick rib rather than a thin fibrous wing. It remains to be seen whether this is an abnormality when the plant next flowers.

2. Begonia danumensis F.Y. Chong **sp. nov.** (Section *Petermannia*)

In its habit, non-oblique leaves and hairs on the upper leaf surface, it is most similar to *Begonia fuscisetosa* Sands (1997: 433), but it is different from this species in its obovate leaves, less than three times longer than wide (vs. elliptic leaves, more than three times longer than wide as in *B. fuscisetosa*), many flowered inflorescences (vs. few flowered ones) and fruit stalks shorter than the capsule (vs. longer than the capsule). Type: *Chong et al. SAN 156802*, Borneo, Sabah, Lahad Datu, Danum Valley Conservation Area, Nature Trail, 26 July 2014 (holotype SAN!; isotypes KEP!, K!, SAR!, SING!, SNP!). **(Fig. 3)**

Robust begonia to 1 m tall, becoming bushy with a few erect branches from the base, individual stems unbranched or sometimes two-branched with short lateral branches. Stems greenish brown, woody, *c*. 7 mm diameter, pubescent, hairs white, internodes 3.5–5.5 cm long, swollen at the nodes. Stipules dark red, pubescent, lanceolate, 12–14 × 4–6 mm, margin entire, apex setose, seta *c*. 1 mm long, caducous. Leaves alternate and distant or with an extremely short internode and appearing opposite, not oblique, held more or less horizontally; petiole green, pubescent, 1–1.7 cm long, flat above; lamina plain rice green, with a row of short dark red bristles with a white tip between the veins, thin in life, matt, obovate, slightly asymmetric, 13–17.5 × 5–7 cm, broad side 2.7–4 cm wide, basal lobe rounded, 0.4–1.2 cm long, margin minutely toothed, apex attenuate to acuminate, acumen to 1.5 cm long; venation pinnate with 7 veins on either side of the midrib, twice branched, 2 veins in the basal lobe, concolorous, strongly impressed above and prominent beneath, midrib pubescent above. Inflorescences protogynous, axillary, racemose, reddish green, pubescent, erect, longer than petioles, 4.5–5.5 cm long with peduncle *c*. 3.5 cm long, with 2 female flowers at the base and many male flowers above. Bracts maroon, lanceolate, 4.5–9 × *ca*. 4 mm, pubescent, margin entire, caducous. Bracteoles light brown, triangular, 1–4 × 1–3 mm, margin entire, caducous. Male flower: pedicel pale red, *c*. 4 mm long; tepals 2, outside deep pink with dark red hairs, inside white pink towards the base, broadly oval, *c*. 5 × 4 mm, margin entire, apex rounded; stamens 25–28, cluster conical, shortly stalked; filament pale yellow; anthers pale yellow, obovate, *c*. 1 × 0.5 mm, apex emarginate. Female flower: pedicel *c*. 6 mm long, pale green, white or red, hairy; ovary pale green, narrowly triangle, *c*. 1.5 × 1.2 cm, wings 3, more or less equal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, pale green, equal, *c*. 7 × 5 mm, margin denticulate, with a single pair of teeth in the upper half of the apex; styles 3, pale yellowish green, *c*. 2.5 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Capsules (1.6–)1.8(–2.3) × 1.4–1.7(–1.9) cm, locules 3, wings 3, equal, rounded proximally, distally truncate with a pointed tip, *c*. 6 mm wide, thinly fibrous, dehiscing between the locule and the wing, pendent, pedicel stiff, 4–8 mm long. Seeds ellipsoid, *c*. 0.4 × 0.2 mm, columnar cells more than half of seed length.

ETYMOLOGY. It is named for the locality because it is one of the most common species in DVCA.

Fig. 3. *Begonia danumensis*. **A.** Habit; **B.** Male inflorescence; **C.** Female flower; **D.** Fruits and unopened male flowers. All photos from *SAN 156802* by Julia Sang.

ECOLOGY. This is the most common begonia species in DVCA and was found along all trails visited in lowland mixed dipterocarp forest on slight slopes in deep shade or on the side of gullies to 150 m elevation. From the few herbarium collections, it appears to have been overlooked by collectors. It often grows together with *B. rotundibracteata* Kiew that is similar in habit.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Field Centre Nature — South Side, *Argent et al. 141987* (SAN), Nature Trail, *Chong, F.Y. et al. SAN 156802* (holotype SAN!; isotypes KEP!, K!, SAR!, SING!, SNP!); Main Trail East, *Gregson & Bala Ola 85* (SAN); Ulu Segama, *Diwol SAN 109680* (SAN), Ulu Sg. Segama, *Argent et al. 107700* (SAN).

3. Begonia dimorpha S. Julia **sp. nov.** (Section *Petermannia*)

It is similar to *Begonia malachosticta* Sands (1990: 64) in being a cane-like begonia with large, pendent, spotted leaves and female flowers located in the lower leaf axils with the male inflorescences terminal. However, *B. dimorpha* is different in having white or pink spots in the young leaves, disappearing in the adult leaves that are plain green and the flowers are not produced on the main stem but on horizontal lateral branches. Type: *Chong et al. SAN 157257*, Borneo, Sabah, Lahad Datu, Danum Valley, Borneo Rainforest Lodge, Coffin Trail, 27 July 2014 (holotype SAN!; isotypes KEP!, SAR!, SING!, SNP!). **(Fig. 4)**

Cane-like glabrous begonia, erect, to 117 cm tall, main stem unbranched with lateral horizontal branches towards the apex. Stems reddish, becoming brown and woody, *c.* 5 mm diameter, internodes 5.1–9.2 cm long, thicker at the nodes. Stipules pale green, lanceolate, 16–21 × 5–10 mm, midrib keeled outside, margin entire, apex setose, seta to 8 mm long, caducous. Leaves alternate, distant, oblique, hanging downwards; petiole reddish, terete, on main stem 4.4–6.1 cm long, on lateral branches 0.9–1.9 cm long; lamina of young plants with rows of white or pink spots between the veins and with a white or pink line around the margin; leaves of mature plants plain dark green with a red blotch at the junction of the lamina and petiole, in juvenile and mature leaves completely deep magenta or tinged magenta beneath, matt, slightly fleshy in life, ovate, asymmetric; lamina on the main stem 10.3–16.3 × 6.2–8 cm, broad side 4.1–5.1 cm wide, basal lobe rounded, 3.7–5.6 cm long, margin remotely and minutely toothed, apex attenuate, lamina of lateral branches smaller, *c.* 8.7 × 4.4 cm, broad side *c.* 2.6 cm wide, basal lobe *c.* 2.3 cm long; venation palmate-pinnate, with a pair of veins at the base of the midrib, 2–3 veins on either side of the midrib, branched once or twice, 4 veins in the basal lobe, slightly impressed above, beneath paler and slightly prominent. Inflorescences protogynous; female flowers axillary, 1–3, each single from lower leaf axils; male inflorescences terminal, cymose, few-flowered, *c.* 3.8 cm long, peduncle thin, *c.* 3.4 cm long, pale green or magenta. Bracts pale green, narrowly lanceolate, *c.* 11 × 4 mm, margin entire, apex setose, seta *c.* 0.3 cm long, persistent. Bracteoles minute. Male flower (bud) cherry red or white outside, pedicel cherry red or white, *c.* 4 mm long; tepals 2, oval, *c.* 4 × 4 mm, margin entire, apex broadly acute; stamens 56–60, cluster subglobose, sessile; filaments pale yellow, 0.7–1 mm long; anthers pale yellow, obovate or oblong, 0.5–0.6 × *c.* 0.3 mm, apex emarginate. Female flower: pedicel *c.* 4 mm long, pale green; ovary

green tinged pink, *c*. 3 × 2.5 cm, wings 3, subequal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, all white, elliptic, 4 larger *c*. 11 × 7 mm, the fifth narrower *c*. 11 × 5 mm, margin entire, apex broadly acute; styles 3, brownish yellow, *c*. 3.5 mm long, divided to base; stigma white, papillose forming a continuous twisted band. Capsules broadly triangular in outline, 1.7–3.0 × 1.9–2.9 cm, wings subequal, narrowed proximally, truncate distally, tip acute, 0.8–1.0 cm wide, thinly fibrous, dehiscing between locules and wings, dangling on fine thread-like pedicel, 2.1–3.3 cm long.

ETYMOLOGY. *Dimorpha* (two forms), so named because of the great difference in appearance between the juvenile plants with an erect, unbranched stem with large, spotted leaves and fertile plants with horizontal lateral branches with smaller, plain green leaves.

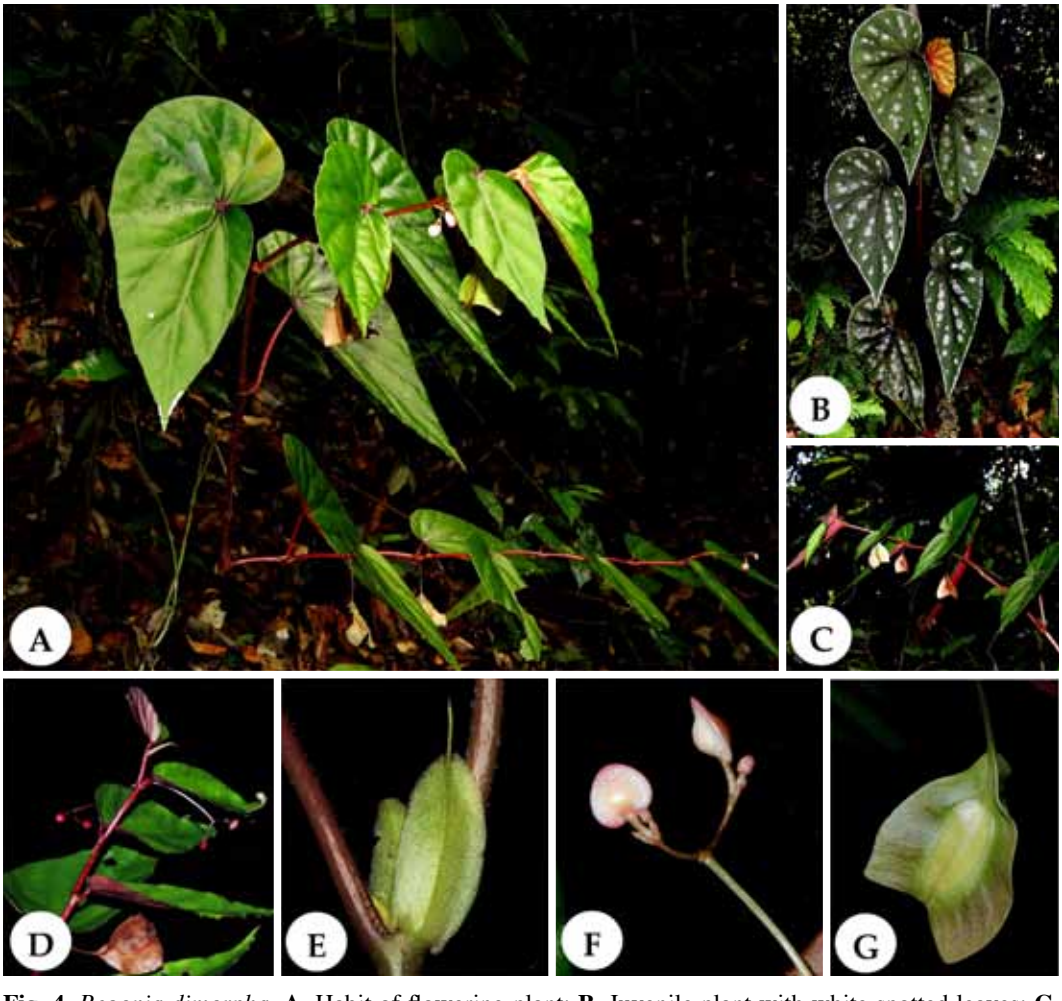

Fig. 4. *Begonia dimorpha*. **A.** Habit of flowering plant; **B.** Juvenile plant with white spotted leaves; **C.** Fruiting lateral twig; **D.** Flowering lateral twig; **E.** Stipule; **F.** Unopened male flowers; **G.** Fruit. All photos from *SAN 157257* by Julia Sang.

ECOLOGY. Occasional in alluvial forest, but only found fertile on very steep, lightly shaded slopes at 310 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMEN EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, Borneo Rainforest Lodge, Coffin Trail, *Chong et al. SAN 157257* (holotype SAN!; isotypes KEP!, SAR!, SING!, SNP!).

NOTES. A striking species when young because of its bright white or pink spotted leaves. Unfortunately, this variegation is lost in mature plants, or it would be an attractive ornamental plant.

4. Begonia gomantongensis Kiew (1998: 164) (Section *Petermannia*). Type: *James Awing SAN 47257*, Borneo, Sabah, Kinabatangan, Gomantong, Bukit Dulong Lambu, 11 October 1964 (holotype SAN!).

Cane-like begonia, erect, to 60 cm tall. Stems sparsely branched, young stem minutely bristly, becoming brown and woody, *c*. 4–5 mm diameter. Stipules green, narrowly lanceolate, *c*. 20 × 5 mm, apex acute, caducous. Leaves alternate, distant, oblique, held horizontally; petiole deep purplish, minutely bristly, (6.5–)11(–18) cm long; lamina glossy, plain mid-green to dark green above, pale green beneath, glabrous, obliquely subrotund, asymmetric, 10–16(–30) × (10–)13.5(–23) cm, base cordate, basal lobe rounded, 3.5–8 cm long, margin minutely serrulate, apex shortly acuminate, acumen to 0.5 cm long; venation palmate-pinnate, with a pair of veins at the base of the midrib, 3 veins on either side of the midrib, branching three times before reaching the margin, 2–4 veins in the basal lobe, slightly impressed above, conspicuously prominent beneath. Inflorescences protogynous with 1–2 female flowers from the leaf axil and many male flowers on an erect rachis 2.5–6.5 cm long with short cymose branches *c*. 0.5 cm long. Bracts foliaceous, broadly ovate to semi-circular, *c*. 25 × 17 mm. Bracteoles similar but diminishing in size towards the apex, margin undulate, upper bracteoles enveloping clusters of male flowers and overlapping with the bracteole above. Male flower: pedicel slender, 3–3.5 mm long; tepals 2, white, rotund, 3.5–4 × 3–3.5 mm; stamens (45–)51(–53), cluster obovoid, stalk *c*. 0.75 mm long; filaments *c*. 0.5 mm long; anthers yellow, ovoid, *c*. 1 × 0.5 mm, apex emarginate. Female flower: pedicel pale yellow-green, 10–12 mm long; ovary oblong tapered into pedicel, green tinged pink, *c*. 16 × 11 mm, surface of the locules conspicuously verruculose, wings 3, pale yellowish green, subequal, *c*. 4 mm wide, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, white, elliptic, four outer ones larger *c*. 11 × 7 mm, the innermost narrower *c*. 7 × 4 mm, margin entire, apex acute; styles 3, *c*. 3–4 mm long, divided to base, bifurcating; stigma papillose forming a continuous twisted band. Capsules oblong, 1.7–2(–2.7) × 1.3–1.8 cm, wings 3, equal, broadly rounded proximally, truncate or rounded distally, 4–5 mm wide, stiffly papery, outer surface of locule completely verruculose, dehiscing between the locules

and wings, dangling on fine thread-like pedicel, 2.1–3.3 cm long. Seeds broadly ovoid, *c*. 0.3 × 0.2 mm, columnar cell more than half the seed length.

ETYMOLOGY. Named for the locality from where it was originally collected, Bukit Gomantong being the more familiar name for Bukit Dulong Lambu.

ECOLOGY. In DVCA, it is a relatively common species growing on clay soil in lowland mixed dipterocarp forest between 200–500 m elevation. At the type site, it grows at the foot of limestone cliff faces or on limestone boulders in deep shade.

DISTRIBUTION. Borneo. Endemic to Sabah.

SPECIMENS EXAMINED — BORNEO. SABAH: Lahad Datu District: Borneo Rainforest Lodge, Coffin Cliff Trail, *Gregson et al. 122* (SAN), *Gregson et al. 123* (SAN); Gusher Waterfall, *Campbell EG 241* (SAN), trail to Fairy Waterfall, *Chong et al. SAN 157258* (E, K, KEP, KNP, SAN, SAR, SING); Segama River, *Andrews 751* (SAN), Sg. Danum Segama, *Cockburn SAN 85047* (KEP, SAN); Danum Valley Field Station Centre — South side, *Argent et al. 211987* (SAN), Nature Trail, *Chong et al. SAN 156803* (KEP, SAN, SAR, SING); Sandakan District: Gomantong FR, *Lim SP 785* (SAN); Bukit Dulong Lambu, *James Awing SAN 47257* (holotype SAN!).

NOTES. This species is distinct in its oblong capsules and the distinctly pimply surface of the locules.

5. Begonia gueritziana Gibbs (1914: 82). Section *Baryandra*. Type: *Gibbs 2892*, Borneo, Sabah, Tenom District, Kayoh Hills, January 1910 (holotype BM).

Rhizomatous begonia. Rhizomes brownish red, densely pubescent, 4–5 mm diameter, internodes 2–4 mm long. Stipules pubescent, narrowly lanceolate, 6–8 × 2–4 mm, margin entire, apex setose, seta 1–1.5 mm, persistent. Leaves alternate, crowded, oblique; petiole erect, densely pubescent to hispid, (3.5–)10(–14) cm long, terete; lamina plain dark green above, often reddish purple beneath, glossy and slightly fleshy in life, broadly ovate, asymmetric, (3.5–)7(–9.5) × (4–)6(–7.5) cm, broad side 2–5 cm wide, base cordate, basal lobes rounded, 0.3–1.8 cm long, margin entire, slightly undulate, ciliate, apex acute to acuminate; venation palmate, veins 5–6(–7), concolorous, pubescent beneath, plane above and prominent beneath. Inflorescences protandrous, axillary, erect and longer than petioles, cymose, (9–)20(–38) cm long, peduncle slender (8–)16(–30.5) cm with few branches 3(–8) cm long at the apex. Bracts pink, lanceolate, *c*. 7 × 2 mm, margin entire, caducous. Bracteoles lanceolate, *c*. 3 × 1.5 mm, caducous. Male flowers: pedicel 4(–11) mm long; tepals 4, pink, sometimes white, margin entire, apex rounded, outer two broadly elliptic, 9–12 × 5–8 mm, inner two narrowly elliptic to narrowly obovate, *c*. 11 × 3 mm; stamens *c*. 25, cluster shortly stalked, *c*. 1 mm long; anthers pale yellow. Female flower: pedicel red, 6–9 mm long; ovary pale green, glabrous, 5–9 × 4–11 mm, locules 2, placentas bilamellate, wings 3, unequal,

larger wing *c*. 4–7 mm wide, narrower two *c*. 2 mm wide; tepals 4, rosy pink, sometimes white, outer two almost rotund, 5–9 × 5–8 mm, inner two elliptic, 4–8 × 4–5 mm; styles and stigma yellow, styles 2.5–3 mm long, bifurcating, stigma a twisted continuous papillose band. Capsules (7–)11(–15) × (9–)14(–17) mm, glabrous, wings 3, very unequal, one wing greatly enlarged, slightly concave, *c*. (5–)10(–14) mm wide, broadly rounded, smaller two wings (2–)3(–7) mm wide, thinly fibrous, dehiscing between locule and wing, pendent, pedicel stiff, 10–17 mm long.

ETYMOLOGY. Named in honour of Edward Peregrine Gueritz, Governor of British North Borneo (1904–1911), who facilitated L.S. Gibb's expeditions.

ECOLOGY. It grows in soil-filled crevices and ledges in rock. In DVCA it has only been collected from Coffin Cliff that is composed of East Sabah Mélange rock type (Hazebroek *et al*., 2012). Elsewhere it grows on limestone, basalt, gabbro or sandstone (Kiew, 2001). It most commonly grows in the lowlands but on Gunung Kinabalu it has been collected at 750 m elevation.

DISTRIBUTION. Borneo. Endemic but widespread in Sabah. In DVCA, it was only collected from rocks at the Coffin Cave.

CONSERVATION STATUS. Least Concern.

SPECIMENS EXAMINED—BORNEO. SABAH: Beluran District: Labuk Sugut, *Meijer SAN 51623* (SAN), Labuk Sugut, Kiabau, *Meijer SAN 43816* (SAN), Labuk Sugut, Lubok Buaya, *Meijer SAN 23103* (SAN); Keningau District — Ulu Sungai Punteh, *Fidilis SAN 125408* (SAN), Ulu Sungai Mentuluk, *Fidilis SAN 113288* (SAN); Kinabatangan District: Lamag, *Diwol Harun SAN 89912* (SAN), *Majawat et al. SAN 88005* (SAN), *Sing & Eging SAN 51826* (SAN), Sukau, *Lim et al. LSP 1151* (SAN), Batu Puteh, *Lim et al. LSP 625* (SAN), Dermakot FR, *Aban & Suin SAN 66302* (SAN), Keruak, *Gambating & Martin, SAN 108092* (SAN), Batu Puteh, *Sands & Wong Sands 6022* (SAN), *Lim et al. LSP 771* (SAN), Sukau, *Reza et al. RA 313* (SAN), *Kiew & Lim RK 4183* (SAN), *Kiew & Lim RK 4192* (SAN), *Kiew & Lim RK 4291* (SAN); Kota Marudu District: Marak Parak, *Mansus & Pius SAN 118933* (SAN); Lahad Datu District: Ulu Segama, *Talip SAN 70979* (SAN), Borneo Rainforest Lodge, Coffin Cliff Trail, *Gregson et al.* 117 (SAN), *Chong et al. SAN 157256* (E, KEP, KNP, SAN, SAR, SING); Ranau District: Unspecified locality, *Gambating SAN 118248* (SAN), *Sadau SAN 53857* (SAN), Kampung Miruru, *Aban SAN 90246* (SAN), Kampung Paus, *Gambating SAN 94680* (SAN), Sungai Naputan, *Aban SAN 94570* (SAN), Poring, *Sinit SAN 2551* (SAN), Mt. Kinabalu, *Chew et al. CWL 1187* (SAN), Tenompok, *Sario SAN 27660* (SAN); Sandakan District: Gomantong FR, *Lim et al. LSP 616* (SAN); Tambunan District: Kampung Mansurolong, *Nordin SAN 85913* (SAN); Tawau District: Ulu Balong, *Meijer SAN 28678* (SAN); Tenom District: Unspecified locality, *Maikin SAN 113655* (SAN), Ulu Sungai Kalang, *Berhaman SAN 133057* (SAN), Ulu Kalang, *Kiew & Lim RK 4280* (SAN), Kayoh Hills, *Gibbs 2892* (holotype BM).

NOTES. Very characteristic of this species is the capsule with the larger wing expanded into a concave sail-like structure.

6. Begonia incompta Kiew **sp. nov.** (Section *Petermannia*)

In habit and leaf size and shape, *Begonia incompta* is similar to *B. rotundibracteata*, but it is different in its longer internodes 4–8 cm long (vs. 2.5–4 cm as in *B. rotundibracteata*), its small lanceolate bracteoles *c*. 6 × 2 mm (vs. 6–9 × 4–9 mm), its male flowers with shorter pedicels 1–6 mm long (vs. 12 mm) and smaller tepals 4–5 × 4 mm (vs. *c*. 8 × 8 mm). Type: *Chong et al. SAN 157261*, Borneo, Sabah, Lahad Datu, Danum Valley, Borneo Rainforest Lodge, Fairy Waterfall Trail, 27 July 2014 (holotype SAN!; isotypes KEP!, SAR!, SING!). **(Fig. 5)**

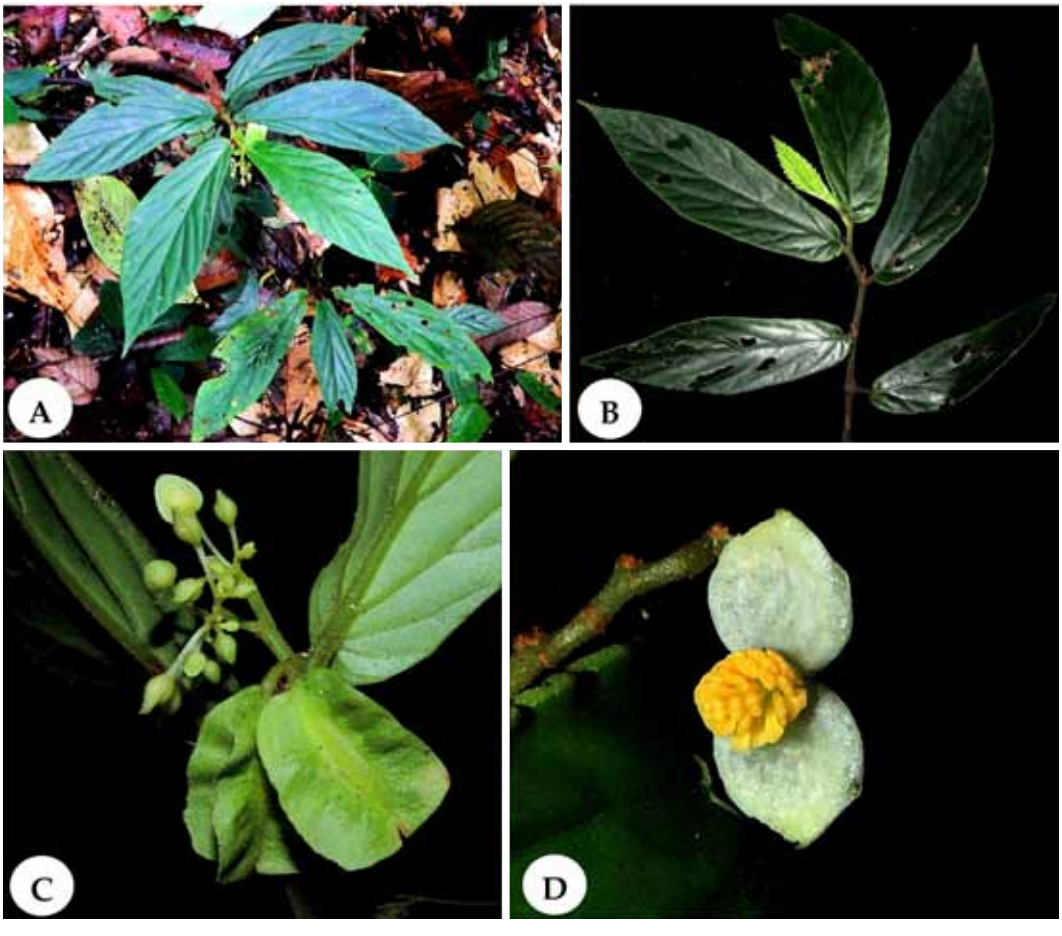

Fig. 5. *Begonia incompta*. **A.** Habit; **B.** Leafy twig; **C.** Male inflorescence and fruits; **D.** Opened male flower. Photo **A** from *SAN 157261* by Martin Tuyok; Photos **B**–**D** from *SAN 157261* by Julia Sang.

Erect begonia to 87 cm tall. Stems dull green, brownish pubescent, *c*. 6 mm diameter, internodes 4–8 cm long, nodes strongly swollen. Stipules pale green, pubescent, lanceolate, 8–16 × 2.5–4 mm, margin entire, apex sharply acute, caducous. Leaves alternate and distant or sometimes appearing opposite, not oblique, held horizontally; petiole dull green, pubescent, (0.8–)2(–3) cm long, terete; lamina plain dark green above, paler beneath, slightly fleshy in life, matt, glabrous on both sides, elliptic, asymmetric, (12.5–)17(–22) × (5–)6(–7.5) cm, broad side 3.2–4.2 cm wide, base unequal, lobes sometimes overlapping, basal lobe (0.5–)0.8(–1.2) cm long, margin minutely toothed, apex acute to acuminate, acumen to 1.5 cm long; venation pinnate, 5–7 veins on each side of midrib, once or twice branched, 1–2 veins in basal lobe, midrib and veins concolorous, veins impressed above, prominent and pubescent beneath. Inflorescences protogynous, axillary, sessile, racemose with cymose branches, rachis dull green, pubescent, erect, (1.2–)3(–5.5) cm long, with one or two female flowers and many male flowers. Bracts lanceolate, *c*. 7 × 2 mm, margin entire, caducous. Bracteoles lanceolate, *c*. 6 × 2 mm, margin entire, caducous. Male flowers (young): pedicel greenish white, 1–3(–6) mm long; tepals 2, greenish white, minutely pubescent outside, oval, 4–5 × *c*. 4 mm, margin entire, apex rounded; stamens *c*. 33, cluster conical, shortly stalked; filaments pale green, *c*. 1 mm long; anthers pale green, oblanceolate, 1–1.3 × *c*. 0.5 mm, apex bluntly acute. Female flower not available. Capsules single or in pairs, (1.6–)1.9(–2.4) × (1.4–)1.7(–1.8) cm, glabrous, wings 3, equal, wing rounded proximately, pointed distally, 6–7 mm wide, thinly fibrous, dehiscing between locules and wing, pendent, pedicel stiff, (4–)6–9 mm long.

ETYMOLOGY. *Incomptus* (unadorned), referring to the very plain appearance of this species.

ECOLOGY. In lowland mixed dipterocarp forest on steep slopes above streams or by paths in light shade at *c*. 180 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, Borneo Rainforest Lodge, Fairy Waterfall trail, *Chong et al. SAN 157261* (holotype SAN!; isotypes KEP!, SAR!, SING!); Danum Valley Field Centre, East trail, *Madani SAN 112914* (SAN), Trail to Water Pool, *de Kok* 1038 (KEP, SAN), Main trail East, *Gregson 46* (KEP, SAN).

7. Begonia inopinata V.S. Guanih **sp. nov.** (Section *Petermannia*)

Similar to *Begonia postarii* in inflorescence structure, its conspicuous bracteoles and many small male flowers, but *B. inopinata* is different in its smaller stipules 17–18 × 6–6.5 mm (vs. to 25 × 15 mm as in *B. postarii*), its glabrous lamina 12.5–14.5 × 7–8 cm that is longer

than wide (vs. conspicuously hairy on both surfaces and (8–)11(–17) × 7–9(–12.5) cm that is almost as wide as long), its smaller male outer tepals 4–5 × 2–3 mm (vs. 7–8 × 4.5–5 mm long) and larger, glabrous fruit 15–17 × 17–19 mm (vs. hispid and (8–)12 × (–9)13(–17) mm long). Type: *George et al. SAN 123711*, Borneo, Sabah, Lahad Datu District, KM 46, Jalan Danum, 12 March 1988 (holotype SAN!).

Cane-like begonia to 60 cm tall. Stems erect, *c*. 3 mm diameter, hispid towards the apex, hairs rusty brown when dry, internodes 5.5–7 cm long. Stipules oblong, 17–18 × 6–6.5 mm, midrib keeled, margin dentate, densely hispid, apex setose, seta *c*. 3 mm long, persistent. Leaves alternate, distant, oblique; petiole hispid, 2.5–8.5 cm long, slightly grooved above; lamina plain dark green in life, thinly leathery and khaki on both surfaces when dry, glabrous on both surfaces, ovate, asymmetric, 12.5–14.5 × 7–8 cm, broad side 5–6.2 cm wide, basal lobe broadly rounded, 4.2–4.5 cm long, margin shortly toothed, apex acuminate, acumen to 1.5–2.5 cm long; venation palmate-pinnate, 2–3 veins on either side of midrib, branching 2–3 times, 3–4 veins in basal lobe, midrib and lateral veins brown beneath, impressed above, slightly prominent beneath. Inflorescences protogynous, in the uppermost leaf axils, 10–16 cm long, peduncle 4–4.5 cm long, rachis sparsely hispid, a pair of female flowers at the base, above with cymose branches with many male flowers, branches 2.5–3 cm long. Bracts caducous. Bracteoles oval to reniform, margin toothed and studded with stalked glands, 3.5–6 × *c*. 3 mm, persistent. Male flowers: pedicel 2.5–6 mm long; tepals 4, reddish purple, glabrous, margin entire, outer 2 tepals elliptic, 4–5 × 2–3 mm, apex acute; inner 2 tepals narrowly elliptic, 3 × 1–1.5 mm; stamens *c*. 22, cluster conical, sessile; filaments 0.2–0.4 mm long; anthers obovate, 1–1.2 × 0.5 mm, apex emarginate. Female flower not available. Capsules bell-shaped in outline, 1.5–1.7 × 1.7–1.9 cm, glabrous, locules 3, wings equal, rounded proximally, distally tip pointed, 7–10 mm wide, thinly fibrous, dehiscing between the locules and wings, pedicel *c*. 15 mm long.

ETYMOLOGY. *Inopinata* (unexpected), so-called because it was discovered mixed with herbarium specimens of *B. postarii*.

ECOLOGY. On the side of a valley in submontane forest at 800 m or by rivers.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, Gunung Danum, East Ridge, *Argent et al. 1987156* (KEP, SAN); Danum Valey Road, Mile 46, *Majawat SAN 123711* (holotype SAN).

NOTES. This species was not encountered during the present field survey, probably because it grows at higher elevations, being reported from submontane forest.

8. Begonia inostegioides F.Y. Chong **sp. nov.** (Section *Petermannia*)

It belongs to the *B. inostegia* group of species that has corrugate leaves and within this group it is similar to *Begonia gomantongensis* in habit and leaf venation, but *B. inostegioides* is different in its smaller stipules *c.* 7 × 1 mm (vs. *c.* 20 × 5 mm as in *B. gomantongensis*), its longer petioles 1.7–7.5 cm long (vs. (6.5–)11(–18) cm long), its narrower, ovate lamina 6.7–9.5 cm wide (vs. sub-rotund and (10–)13.5(–23) cm wide), its male flowers with long pedicels 6–8 mm long and oval tepals *c.* 5 × 5 mm (vs. with pedicels 3–3.5 mm long and rotund tepals, 3.5–4 × 3–3.5 mm) and its narrower capsule that has locules with a smooth surface and a short stalk *c.* 5 mm long (vs. with locules having a conspicuously pimply surface and a stalk 15–25 mm long). Type: *Chong et al. SAN 157804*, Borneo, Sabah, Lahad Datu District, Danum Valley Field Centre, Riverine Trail, 26 July 2014 (holotype SAN!; isotype KEP!). **(Fig. 6)**

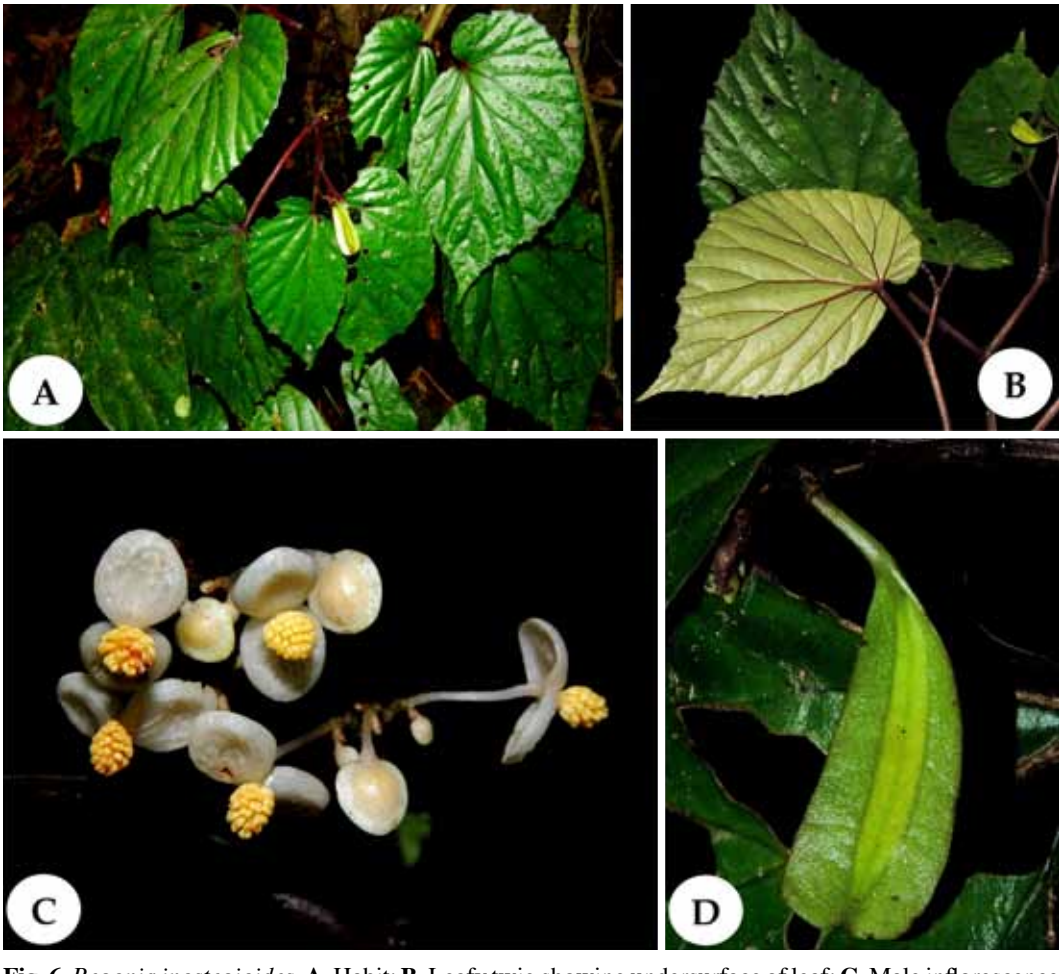

Fig. 6. *Begonia inostegioides*. **A.** Habit; **B.** Leafy twig showing undersurface of leaf; **C.** Male inflorescence with opened flowers; **D.** Fruit. All photos from *SAN 156804* by Julia Sang.

Cane-like begonia, 25–30 cm tall. Stems erect, dark green or reddish, glabrous, woody, *c*. 5 mm diameter, branching with lateral side shoots, internodes 3.5–7 cm long, thicker at nodes. Stipules red, glabrous, narrowly lanceolate, *c*. 7 × 1 mm, margin entire, apex acute, caducous. Leaves alternate, distant, oblique, held more or less horizontally; petiole greenish brown or red, glabrous, 1.7–7.5 cm long, grooved above; lamina plain dark green, thin in life, matt, ovate, asymmetric, 10–15.7 × 6.7–9.5 cm, broad side *c*. 4 cm wide, basal lobe rounded, *c*. 1.1 cm long, margin shallowly toothed, apex acuminate, acumen to 1.5 cm long; venation pinnate, 4 veins on each side of the midrib, branching once, 2 veins in basal lobe, on upper surface reddish toward the base with a line of raised red short hairs and veins impressed above, beneath greenish brown and prominent. Inflorescences protogynous, racemose, erect, greenish or red, glabrous, *c*. 2.5 cm long, peduncle *c*. 0.9 cm long, branches 3, each branch 2–3 mm long with many male flowers. Bracts caducous. Bracteoles minute, less than 1 mm long. Male flowers white, pedicel 6–8 mm long; tepals 2, completely white, glabrous, oval, *c*. 5 × 5 mm, entire, apex slightly acute; stamens 35–38, cluster globose, stalked, *c*. 0.5 mm long; filaments pale yellow, *c*. 1.5 mm long; anthers pale yellow, oblong, *c*. 0.5 × 0.3 mm, apex emarginate. Female flower not available. Capsules positioned under the leaves, oblong, *c*. 2 × 0.9 cm, glabrous, wings 3, equal, narrow proximally, rounded distally, 3 mm wide, thinly fibrous, dehiscing between the locules and wings, pedicel stiff, *c*. 5 mm long.

ETYMOLOGY. Named for its resemblance to *Begonia inostegia* Stapf (1894: 166) from Gunung Kinabalu in habit and the lamina with narrowly parallel, impressed veins.

ECOLOGY. Slope above a small stream.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMEN EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Field Centre, Riverine Trail, *Chong et al. SAN 157804* (holotype SAN!; isoptype KEP!).

NOTES. There are no specimens in SAN of this species apart from the type, probably because it has been overlooked due to its similarity to the more common *B. gomantongensis*.

9. Begonia postarii Kiew (1998: 165). Type: *Kiew & Lim RK 4221*, Borneo, Sabah, Kinabatangan District, Bukit Panggi, 19 September 1996 (holotype SAN!; isotype SING).

Cane-like begonia, 40–60 cm tall, beginning to flower at 20 cm tall, hispid with white (sometimes red) hairs 1–3 mm long on the stem, stipules, petioles, lamina (both upper and lower surfaces), bracts, inflorescence, and ovary. Stems erect, reddish, *c*. 8 mm diameter. Stipules foliaceous, broadly elliptic, *c*. 25 × 15 mm, keeled, margin entire with a dense fringe of hairs, apex rounded or slightly acute, persistent. Leaves alternate, distant, oblique; petiole reddish, (4–)6–8 cm long; lamina plain pale green above and beneath, soft and thin in life, thinly papery when dry, ovate, asymmetric, (8–)11(–17) × 7–9(–12.5) cm, broad side 4–9 cm wide, base cordate, basal lobe rounded, (2.7–)6–8 cm long, margin minutely dentate,

apex cuspidate, acumen 1.25–1.5 cm long; venation pinnate, 4–5 veins on each side of the midrib, branching twice, 2 pairs veins at base, 1 vein in basal lobe, veins slightly impressed above, prominent beneath. Inflorescences protogynous, racemose, erect and reaching above the leaves, 9.5–26.5 cm long, peduncle 5.5–7 cm long, lowest 1–2 branches, 1.5–3.5 cm long with 2–3 female flowers, upper branches reddish, 1.5–3 cm long with many male flowers. Bracts pale green, broadly oval, *c*. 15 × 10 mm, margin minutely toothed. Bracteoles pale green tipped red, broadly ovate, *c*. 3 × 4 mm with dentate margin each tooth tipped by a long glandular hair. Male flowers: pedicel to 8 mm long; tepals 4, outer two white tinged pink merging to cherry red towards centre or deep pink or red with a white margin, elliptic, 7–8 × 4.5–5 mm, entire, apex rounded, conspicuously hirsute outside, inner pair glabrous, narrowly lanceolate, 7 × 1.3–2 mm; stamens 23–35, cluster conical, stalk *c*. 2 mm long, filaments *c*. 0.5 mm long, anthers yellow, *c*. 1 × 0.5 mm, apex emarginate. Female flower: pedicels reddish, 7–10 mm long; ovary broadly ovate, *c*. 3 × 4 mm, wings crimson, *c*. 2 mm wide, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, pink, margin entire, apex rounded, outer broadly ovate, *c*. 8 × 4 mm, inner narrower, *c*. 4.5 × 2.5 mm; styles *c*. 3 mm long, divided to base, bifurcating, stigma papillose forming a continuous twisted band. Capsules broadly ovate, (0.8–)1.2 × (0.9–)1.3(–1.7) cm, wings 3, equal, rounded proximally, 3 mm wide, thinly papery, dehiscing between the locule and wing, pendent, pedicel thin, thread-like, 1–2 cm long. Seeds ovoid, *c*. 0.4–0.3 mm.

ETYMOLOGY. Named in honour of Postar Jaiwit, research assistant in the Herbarium, Forest Research Centre, and diligent plant collector, who discovered this species.

ECOLOGY. Lowland mixed dipterocarp forest, particularly common on banks above rivers at low elevations but also widespread and collected from rocky areas, ultramafic soils (Gunung Nicola) and lower montane forest to 800 m elevation; elsewhere in deep shade at the base of limestone hills at about 100 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah.

SPECIMENS EXAMINED—BORNEO. SABAH: Beluran District: Bidu-Bidu FR, *Suzana et al. SAN 150044* (SAN); Lahad Datu District: DVCA, Gunung Nicola, *Campbell EG 265* (SAN); Danum Valley, *Ridsdale & Postar SAN 148789* (SAN, KEP); Km 46, Jalan Danum, *Majawat et al. SAN 123711* (SAN); Gunung Danum, East Ridge, *Argent et al. 1987156* (SAN), *Argent et al. SAN 1987153* (SAN); path from field centre to water pool, *de kok 1043* (SAN), Ulu Sg. Segama; Coffin Trail, *Gregson & Bala Ola 92* (SAN), Segama East Trail, *Madani SAN 112901* (SAN), Next to Rhino trail, *Clark 28* (SAN), Ulu Segama, Malua FR, *Suzana et al. SAN 154625* (SAN), BRL, Coffin Trail, *Campbell EG 225* (SAN), BRL, Jacuzzi trail, *Chong et al. SAN 157255* (KEP, SAN, SING); Sandakan District: Gomantong, *Bousi et al. SAN 122763* (SAN), Gomantong FR, *Lim & Ubaldus LSP 802* (SAN), Kinabatangan District: Lower Kinabatangan, Subak Estate, *Dransfield et al. JD 5770* (SAN); Sapulut District: Sg. Sansiang, *Jamirus et al. SAN 154782* (SAN), Bukit Panggi, *Kiew & Lim RK 4221* (holotype SAN!; isotype SING).

NOTES. It is a striking species in its broad softly hairy leaves with long inflorescences held above the leaves with many tiny deep red male flowers. It is the most commonly collected species from DVCA. Previously it was known only from limestone hills along the Kinabatangan River. Compared with the Kinabatangan population that has fruits 1 × (0.9–)1.3 cm, the DVCA population has broader fruits 1–1.2 × 1.4–1.7 cm but otherwise there are no significant differences between the two populations.

10. Begonia prasinimarginata S. Julia **sp. nov. (**Section *Petermannia*)

Similar to *Begonia heliostrophe* Kiew (2001: 262) in its leaf shape and inflorescence type, *B. prasinimarginata* differs in its smaller stature, it grows to *c.* 8 cm tall (vs. to 125 cm tall as in *B. heliostrophe*), its leaves have very short petioles, 0.8–1.4 cm long with a lamina twice as long as wide, 9–14.5 × 5.5–6.5 cm and a broad silvery pale green border (vs. with a petiole 5–7 cm long and a plain green lamina, three times longer than wide, 10.5–19 × 3.5–6.5 cm), its male flowers have two tepals (vs. four tepals) and its fruit is smaller *c.* 1.2 × 1.4 cm (vs. 1.7–2.3 × 1.7–2.2 cm). Type: *Diwol SAN 144346*, Borneo, Sabah, Lahad Datu District, Danum Valley Field Centre, Sungai Ril, Danum Segama, 22 March 2000 (holotype SAN!). **(Fig. 7)**

Low glabrous begonia. Stems decumbent and rooting at the nodes, erect apex to 8 cm tall, slightly woody, 2–3 mm diameter when dry, internodes 1.5–2.5 cm long. Stipules lanceolate, *c.* 5 × 2.5 mm, margin entire, apex acute, caducous. Leaves alternate, distant, oblique; petiole reddish brown, 0.8–1.4 cm long, grooved above; lamina dark green above with a broad silvery pale green border, 6–9 mm wide, thin in life, matt, ovate, asymmetric, 9–14.5 × 5.5–6.5 cm, broad side 4–4.5 cm wide, basal lobe rounded, 2.5–3.5 cm long, margin minutely toothed, apex attenuate; venation pinnate, veins 3 on the broad side, branching once or twice, 2 veins on the narrow side, unbranched, 3 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, in the uppermost leaf axils, racemose with cymose branches with male flowers, *c.* 10 cm long, peduncle *c.* 5.2 cm long. Bracts caducous. Male flowers: pedicel rosy pink, *c.* 3 mm long; tepals 4, oval, 2–2.5 × *c.* 2 mm, rosy pink, inner 2 tepals slightly smaller, margin entire, apex acute; stamens >30, cluster globose, sessile; filaments *c.* 0.5 mm long; anthers oblong, 0.8–1 × *c.* 0.6 mm, apex rotund. Female flower: pedicel *c.* 4.5 cm long, reddish pink, glabrous; ovary reddish pink or greenish red, pendent, *c.* 16 x 13 mm; wings 3, equal, *c.* 3 mm wide; locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, reddish, outer tepals ovate, *c.* 10 × 9 mm, inner ones obovate, *c.* 11 × 5 mm, margin entire, apex rounded; styles 3, bright yellow, 1–1.5 mm long, divided to base, bifurcating, stigma widely Y-shaped, papillose forming a continuous twisted band. Capsules *c.* 1.2 × 1.4 cm, wings equal, triangular, widest midway, *c.* 5 mm wide, thinly fibrous, dehiscing between locules and wings, pedicel *c.* 22 mm long, fine and thread-like.

ETYMOLOGY. *Prasinus* (leek green), referring to the conspicuous pale green margin of the lamina.

Fig. 7. *Begonia prasinimarginata*. **A.** Habit of sterile plant; **B.** Habit of flowering plant; **C.** Male inflorescences; **D.** Open male flower; **E.** Female inflorescence; **F.** Open female flower. Photo **A** from *SAN 156813* by Julia Sang; Photos **B**–**F** from *SAN 156813* by Ubaldus Majawal.

ECOLOGY. Not common, on slopes or in flat alluvial forest, sometimes slightly raised above the leaf litter on banks or on tree roots at 300–660 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: DVCA, Borneo Rainforest Lodge, Coffin trail, *Chong et al. SAN 156813* (nursery grown plant originally collected from DVCA) (SAN), Sungai Ril, Danum Segama, Diwol *SAN 144346* (holotype SAN!).

11. Begonia rotundibracteata Kiew **sp. nov.** (Section *Petermannia*)

Very similar to *Begonia danumensis* in habit, leaf size and shape, but *B. rotundibracteata* is different in its leaf arrangement that is always alternate (vs. alternate and sometimes appearing opposite as in *B. danumensis*), the upper leaf surface is glabrous (vs. with a row of bristles between the veins), the bracteoles are conspicuous, foliose, 6–9 × 4–9 mm and persistent (vs. inconspicuous, triangular, 1–4 × 1–3 mm) and caducous, male flowers have 2 or 3 or 4 tepals, the outer pair *c*. 8 × 8 mm, and 50–52 stamens (vs. 2 tepals, *c*. 5 × 4 mm and with 25–30 stamens), and the female flowers have deep pink entire tepals (vs. pale green denticulate tepals). Type: *Chong et al. SAN 157801*, Borneo, Sabah, Lahad Datu District, Danum Valley Field Centre, Nature Trail, 26 July 2014 (holotype SAN!; isotypes E!, K!, KEP!, SAR!, SING!, SNP!). **(Fig. 8)**

Erect begonia branching from the base, individual erect stems unbranched. Stems 20–66 cm tall, reddish brown, becoming woody, *c*. 10 mm thick, pubescent, internodes 2.5–4 cm long, much thicker at the nodes. Stipules pale green, shortly pubescent, lanceolate, 7–17 × 2–4 mm, margin entire, apex acute, caducous. Leaves alternate, distant, not oblique, slightly pendent,

Fig. 8. *Begonia rotundibracteata.* **A.** Habit; **B.** Female flowers and fruits; **C.** Male flowers and fruit; **D.** Female flower with conspicuous bracts; **E.** Female flower; **F.** Male flowers with conspicuous bracts; **G.** Male flower. All photos *SAN 157801* by Julia Sang.

leaves of young plants iridescent blue; petiole greenish brown, pubescent, uppermost reddish brown, (0.5–)1.2(–1.7) cm long, flat above; lamina plain dark green, paler beneath, glabrous on upper surfaces, slightly leathery in life, matt, lanceolate, widest in the middle or sometimes slightly obovate, asymmetric, (13.5–)15(–18) × (4.2–)7(–9.2) cm, broad side (2.5–)4(–5.5) cm wide, base auriculate, basal lobes 0.3–0.6 cm long, margin minutely toothed, apex narrowly acuminate, acumen 1.1–1.5 cm long; venation pinnate, 8 veins on each side of midrib, branched once or twice, veins concolorous with red or brown pubescence, impressed above, prominent beneath. Inflorescences protogynous, in the lowermost leaf axils or below the leaves with 2 female flowers at the base and a few male flowers above; inflorescences in the upper leaf axils with male flowers only, racemose, erect, longer than petioles, (1–)4(–9) cm long, peduncle *c*. 2.9 cm long, reddish, hairy. Bracts broadly ovate, persistent, reddish in female flowers, greenish in most male flowers. Bracteoles whitish green, foliose, ovate, 6–9 × 4–9 mm (female flowers) or *c*. 10 × 6 mm (male flowers), margin studded with red glands, persistent. Male flower: pedicel pale pink and white towards the apex, *c*. 12 mm long; tepals 2 or 3 or 4, white or pink, outer 2 tepals glabrous, broadly oval, *c*. 8 × 8 mm, margin entire, apex slightly acute; inner tepals 2, 1 or 0, glabrous, narrowly oblong, *c*. 4 × 1 mm, margin entire, apex acute; stamens 50–52, yellow, cluster globose, sessile; filaments pale yellow, 1.5–2 mm long; anthers pale yellow, oblong, *c*. 1 × 0.6 mm, apex emarginate. Female flower: pedicel 5 mm long, rosy red, pubescent with red hairs; ovary pinkish, wings pinkish, triangular in outline, *c*. 1.5 × 1.6 cm, wings 3, equal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, deep pink, margin entire, apex rounded, covered with red hairs outside, 4 broadly oval, *c*. 9 × 7 mm, the innermost tepal narrower, *c*. 9 × 4 mm; styles 3, lemon yellow, *c*. 4.5 mm long, divided to base; stigma lemon yellow, papillose forming a continuous twisted band. Capsules *c*. 1.3 × 1.5 cm, pubescence hairs red, locules 3, wings equal, narrow proximally, distally tip acute, dehiscing between the locules and wings, pendent, pedicel stiff, 5–12 mm long. Seeds oblong, *c*. 0.3 × 0.2 mm, columnar cells more than half of the seed length.

ETYMOLOGY. *Rotundibracteata* refers to the conspicuous rotund foliose bracteoles that persist on the infructescence.

ECOLOGY. Quite common in DVCA, in lowland mixed dipterocarp forest in deep shade at 150–350 m elevation, on moist banks, sometimes close to streams.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Field Centre, East trail, *Lee & Pius SAN 119794* (SAN); South side, *Argent et al. 161987* (SAN); Main trail East, *Gregson 47* (KEP, SAN); Nature Trail, *Chong et al. SAN 157801* (holotype SAN!; isotypes E!, K!, KEP!, SAR!, SING!, SNP!); Trail to Air Terjun Tembaling, *Magintan et al. 527* (SAN), *Poulsen & Albaek 527* (SAN); unspecified locality, *Newman SAN 112165* (SAN), *Campbell SAN 109072* (SAN).

NOTES. *Begonia rotundibracteata* grows together, often side-by-side, with *B. danumensis* (Fig. 9) though it appears to be less common. It is easy to distinguish between these two species because *B. rotundibracteata* has glabrous leaves while *B. danumensis* has a row of bristly hairs between the veins. Since they occupy the same habitat, it raises the question as to why the two species have not hybridised. One possibility is that they are reproductively isolated because they do not share the same pollinator. Their flowers differ in colour, size and the number of stamens. Very little is known about pollination in begonia, and as far as we know there are no records of flower visitors to Bornean species. In Peninsular Malaysia, *Trigona* bees are likely to be pollinators (Kiew, 2005). DVFC is the ideal site for such observations to be carried out. The leaves of young plants are a distinct iridescent blue, a feature not seen in *B. danumensis*.

Fig. 9. Comparison between *Begonia danumensis* and *B. rotundibracteata*. **A.** Habit of *B. danumensis* (above) and *B. rotundibracteata* (below) growing together; **B.** Leaf and male flowers of *B. danumensis* (right) and *B. rotundibracteata* (left); **C.** Male flowers of *B. danumensis* (right) and *B. rotundibracteata* (left). All photos by Julia Sang.

12. Begonia ruthiae S. Julia **sp. nov.** (Section *Petermannia*)

In its conspicuous hairs on the basal lobes, each hair is raised on a conical base, *Begonia ruthiae* resembles *B. conipila* Irmsch. *ex* Kiew (2001: 287), but *B. ruthiae* is different from *B. conipila* in having a narrow bright silvery lamina margin and a contrasting deep green lamina (vs. veins that are lighter yellowish green compared with a dark background lamina as in *B. conipila*), *B. ruthiae* is an erect plant (vs. creeping as in *B. conipila*), the lamina is longer 7–8(–10.3) × 4.7–6(–8.5) cm (vs. 4–7.5 × 3.5–8.5 cm), the male flowers have longer tepals 9–12 mm long and *c.* 30 stamens (vs. 3.5–5 mm long tepals and 10–11 stamens) and the capsule is almost as wide as long (1.2–)1.4(–1.7) × 1.3–1.4 cm (vs. longer than wide (1.1–8 × 1–1.5 cm). Type: *Chong et al. SAN 157254*, Borneo, Sabah, Lahad Datu District, Danum Valley Conservation Area, Borneo Rainforest lodge, Coffin Trail, 27 July 2014 (holotype SAN!; isotypes KEP!, SING!). **(Fig. 10)**

Beautiful small begonia with up to 5 leaves on the soil surface. Stems decumbent to 17 cm long, erect apex 2–6 cm long, reddish brown, 4–5 mm diameter, glabrous, wiry, internodes 0.8–1.5 cm long. Stipules deep pink, glabrous, lanceolate or broadly oval, 6–11 × 7–9 mm, margin entire, apex setose, seta *c.* 1 mm, persistent. Leaves alternate, crowded, oblique; petiole light red, 1.7–4(–6.5) cm long, glabrous, grooved above; lamina velvety, deep green with a silvery margin (some populations without the silvery margin), deep magenta beneath, strongly bullate, thin in life, ovate, asymmetric, 7–8(–10.3) × 4.7–6(–8.5) cm, broad side 3–5.5 cm, base deeply cordate, basal lobe 1.7–2.4(–3.5) cm, with a row of hairs between the veins, hairs red, 1–2 mm long, each hair raised on a conical base, margin minutely toothed, apex acuminate, acumen *c.* 0.8 cm long; venation palmate-pinnate, 3–4 on either side of the midrib, branching twice, 3–4 veins in the basal lobe, veins deeply impressed above, major and minor veins prominent beneath, glabrous. Inflorescences protogynous, axillary in the upper leaf axils, racemose, 3.5–8.5(–15.5) cm long, held above the leaves, peduncle 3.5–4 cm, red, glabrous, erect, 1–2 female flowers at the base, male flowers in sessile cymules of 3–5 flowers. Bracts pale green, broadly lanceolate, (8–)10(–13) × 4–5 mm, margin entire, persistent. Bracteoles pale green, pinkish towards the apex, broadly ovate, 4–9 × *c.* 5 mm, margin entire, persistent. Male flowers: pedicel white, 10–12 mm long; tepals 2, white tinged pink towards the margin, glabrous, broadly oval, 9–12 × 9–10 mm, margin entire, apex acute; stamens *c.* 30, pale yellow, cluster globose, sessile; filaments yellow, 1.5–2 mm long; anthers yellow, oblong, 0.8–1 × 0.6 mm, apex rotund. Female flowers: pedicel 12–15 mm long, rosy red, glabrous; ovary deep magenta, ovate, 7–10 × 7–13 mm, wings 3, unequal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, rosy pink, oval, apex acute, margin entire, subequal, larger tepals 12–13 × 8 mm, smallest tepal 10–13 × 6–7 mm; styles 3, lemon yellow, *c.* 5.5 mm long, divided to base; stigma lemon yellow, papillose forming a continuous twisted band. Capsules broadly oblong, (1.2–)1.4(–1.7) × 1.3–1.4 cm, glabrous, wings 3, one wing slightly larger, 4–6(–7) mm wide, smaller wings 4–5 mm wide, thinly fibrous, dehiscing between the locule and wing, pendent on a fine hair-like pedicel, 1.4–2.2 cm long. Seeds oblong, *c.* 0.3 × 0.2 mm, columnar cells more than half of the seed length.

ETYMOLOGY. Named in honour of Ruth Kiew, the author of *Begonias of Peninsular Malaysia*, who has discovered and described many species of *Begonia* in Borneo, particularly from limestone hills.

ECOLOGY. Locally common, in deep shade on banks in lowland dipterocarp forest with hardly any leaf litter, often on raised roots, on wet rocks along the river at 200–500 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

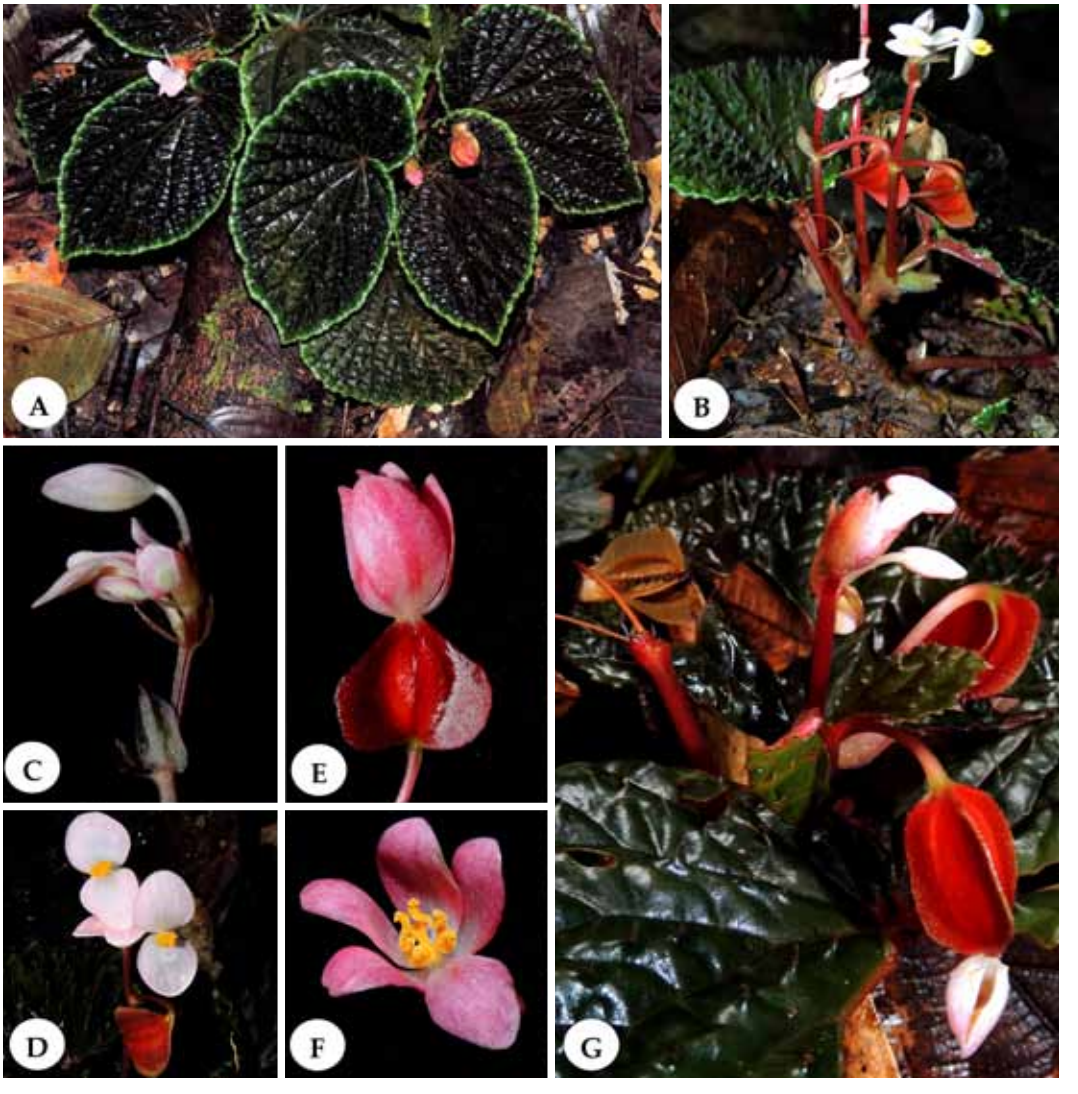

Fig. 10. *Begonia ruthiae*. **A.** Habit; **B.** Male inflorescence and fruits; **C** & **D.** Male flowers; **E** & **F.** Female flower; **G.** Fruit. All photos *SAN 156809* by Julia Sang.

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Conservation Area, Borneo Rainforest Lodge, Segama Trail, *Chong et al. SAN 156809* (SAN), Sg. RIL, *Collector SAN 144328* (SAN); Coffin Trail, *Chong et al. SAN 157254* (holotype SAN!; isotypes KEP!, SING!), *Gregson et al. 125* (SAN); Gunung Danum East ridge, *Argent et al. 1987154* (SAN); over south bridge, *Andrews 740* (SAN).

NOTES. This is a most decorative species worthy of cultivation for its attractive velvety, crinkled, dark green foliage with a bright silvery margin (though this is lacking in some individuals), and its relatively large pink flowers. There is one report (*SAN 84957*) of its leaves being found in the gut of a tortoise.

13. Begonia taniana V.S. Guanih **sp. nov. (**Section *Petermannia*)

Similar to *Begonia imbricata* Sands (1990: 64) in its glossy, wedge-shaped leaves with an undulating margin, but *B. taniana* is different in its caducous stipules (vs. large, 19–30 mm long, and persistent as in *B. imbricata*), glabrous, longer petioles 4–7.5 cm long (vs. hirsute and 1–3.5 cm long), extremely short inflorescences 7 mm long (vs. 70 mm long), narrower bracteoles 8–10 × 5–6 mm that do not overlap (vs. overlapping bracteoles 12–18 × 14–21 mm) and male flowers with two tepals (vs. four tepals). Type: *Chong et al. SAN 156811*, Borneo, Sabah, Lahad Datu District, Danum Valley Conservation Area, Borneo Rainforest lodge, Sapa Bebandil Trail, 28 July 2014 (holotype SAN!). **(Fig. 11)**

Cane-like begonia. Stems erect to 21 cm tall, unbranched, glossy reddish brown, *c*. 6 mm diameter, glabrous. Stipules caducous. Leaves alternate, distant, oblique, slightly pointing upward; petiole rosy red, glabrous, 4–7.5 cm long, grooved above; lamina plain deep green above, dark magenta below, slightly succulent in life, glossy, broadly ovate, asymmetric, *c*. 15.5 × 9.6 cm, broad side *c*. 7.5 cm wide, basal lobe rounded, *c*. 2.5 cm long, margin remotely toothed, slightly scalloped, apex acuminate, acumen to 2.5 cm long; venation palmate-pinnate, 1 pair at the base and 3 on each side of the midrib, 3 veins in basal lobe, glabrous, slightly impressed above, slightly prominent beneath. Inflorescences protogynous, cymose in the uppermost leaf axils, glabrous, *c*. 7 mm long; peduncle *c*. 4 mm long, 1 female flower at base and 3 male flowers above. Bracts pale green, broadly lanceolate, *c*. 12 × 8 mm, margin entire, midrib keeled, persistent. Bracteoles similar to the bracts but smaller, 8–10 × 5–6 mm, caducous. Male flowers: pedicel pink, *c*. 5 mm long; tepals 2, glabrous, oval, *c*. 3.5 × 3 mm, margin entire, apex slightly acute; stamens 15–17, cluster globose, *c*. 2.2 mm long, sessile; filaments pale yellow, *c*. 0.6 mm long; anthers pale yellow, obovate, *c*. 0.6 × 0.4 mm, apex rotund. Female flower: pedicel *c*. 8 mm long, green, glabrous; ovary yellowish, slightly obovate, *c*. 14 × 14 mm, wings 3, equal, green tinged red, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, pink and deeper rosy red towards the centre, slightly obovate, margin slightly toothed towards apex, apex acute, outermost tepal widest, *c*. 16 × 13 mm, inner four tepals isomorphic, *c*. 14 × 10 mm; styles 3, yellow, *c*. 6 mm long, divided to base; stigma yellow, papillose forming a continuous twisted band. Fruits not seen.

ETYMOLOGY. Named in recognition of Tan Jiew Hoe's interest in initiating the Guide to the Begonias of Borneo project and for providing financial support for this and many other field trips.

ECOLOGY. Base of the tree in alluvial forest at 166 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: DVCA, Borneo Rainforest lodge, Sapa Bebandil Trail, *Chong et al. SAN 156811* (holotype SAN!).

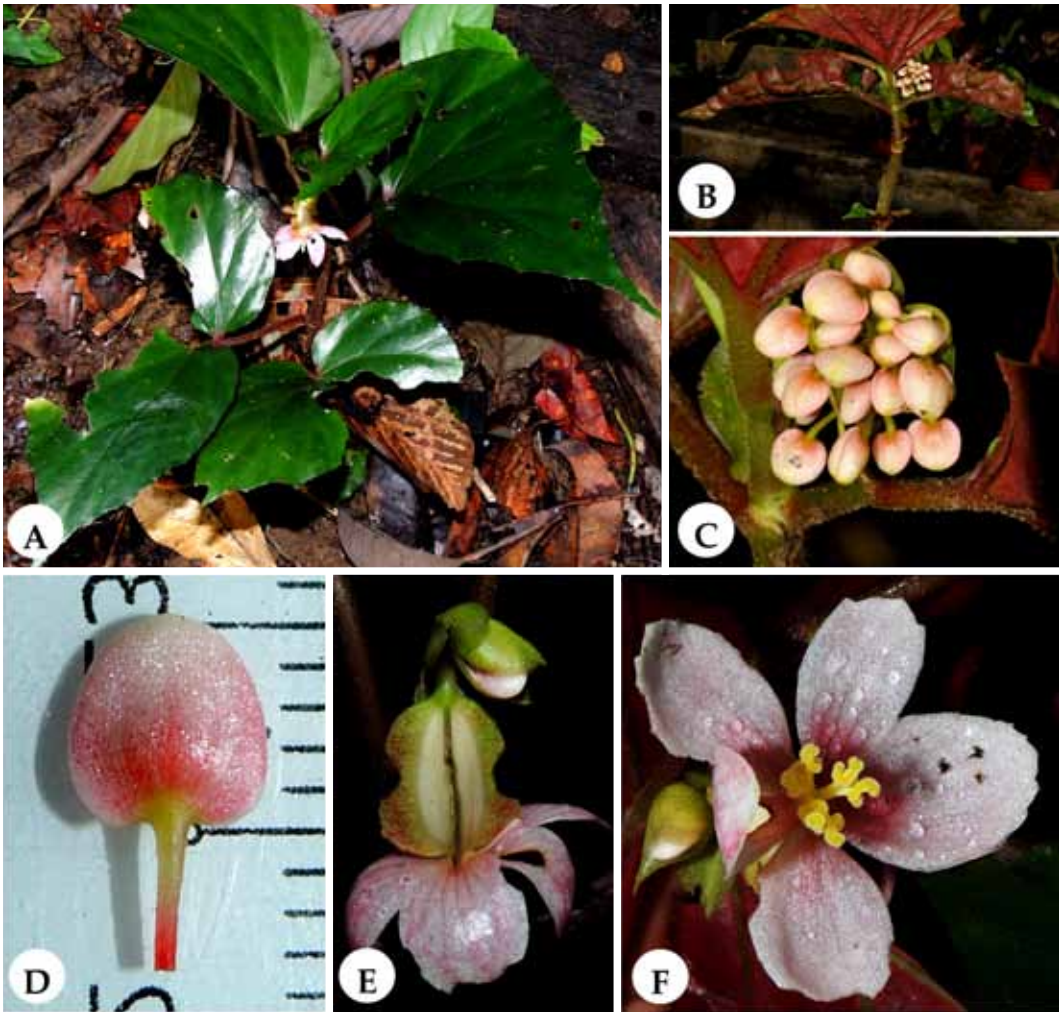

Fig. 11. *Begonia taniana*. **A.** Habit; **B.** Leafy twig with male inflorescence; **C.** Male inflorescence; **D.** Unopened male flower; **E** & **F.** Female flower. Photos **A**, **D**–**F** from *SAN 156811* by Julia Sang; Photos **B** & **C** from *SAN 156811* by Ubaldus Majawal.

NOTES. It is a handsome species that has glossy dark green leaves that are deep magenta underneath and has large, rosy pink female flowers. Although at present it is known from one specimen that lacks the fruit, the species is sufficiently distinct to describe as a new species.

14. Begonia vespipropinqua F.Y. Chong **sp. nov. (**Section *Baryandra*)

In the enlarged concave wing of the fruit, it resembles *Begonia gueritziana* but *B. vespipropinqua* is different in its hairy lamina, with scattered hairs above and densely hairy beneath (vs. glabrous as in *B. gueritziana*), the leaf margin is conspicuously scalloped and minutely dentate (vs. entire) and the basal lobe is well developed, 2.7–5 cm long and often overlapping (vs. small 0.3–1.8 cm and not overlapping) and the capsule is larger, with the largest wing 12–15 mm wide (vs. (5–)10(–14) mm wide). Type: *Chong et al. SAN 156812*, Borneo, Sabah, Lahad Datu District, Danum Valley Conservation Area, Field Centre, Forest behind Education Centre, 28 July 2014 (holotype SAN!). **(Fig. 12)**

Rosette rhizomatous begonia. Rhizome to 33 cm long, *c.* 12 mm diameter, ruby red, glabrous, succulent. Stipules magenta, glabrous, broadly lanceolate, 10–15 × 3–8 mm, or sometimes narrowly lanceolate, *c.* 6 × 2 mm, margin entire, apex acute, caducous. Leaves alternate and crowded, oblique, held horizontally; petiole ruby red, densely short hispid, 7.5–14(–18.5) cm long, *c.* 3 mm thick, terete; lamina plain pale green on both surfaces, fleshy in life, matt, with scattered hairs above, densely hairy beneath, broadly ovate, asymmetric, 6–9(–13) × 7–10(–17) cm, broad side 4–6(–9) cm long, basal lobes often overlapping, 2.7–5 cm long, margin scalloped between the veins, minutely dentate, fringed by hairs (ciliate), apex acuminate, acumen 1–2.5 cm long; venation palmate with 8 veins, concolorous, impressed with scattered hairs above, prominent and densely hairy beneath, hairs white. Inflorescences protandrous, erect, held above the leaves, 17–27.5 cm long, peduncle 15.5–24 cm; pale magenta, glabrous, with a few cymose branches at the top with a few male flowers and one female flower. Bracts caducous. Bracteoles lanceolate, 4–6 × 1.5–2 mm, margin entire, caducous. Male flower: pedicel reddish green, 4–6 mm long; tepals 4, pinkish, margin entire; outer 2 tepals broadly ovate, *c.* 6 × 6.5 mm, apex acute, inner 2 tepals oblanceolate, *c.* 5 × 2 mm; stamens 30–38, cluster globose, sessile, filaments yellow, *c.* 1.6 mm long, anthers yellow, obovate, *c.* 2 × 1.5 mm. Female flower: pedicel greenish red, 5–6 mm long, glabrous; ovary ovate, *c.* 6 × 4 mm, tepals 6, pinkish, margin entire, outer 5 tepals oval, 5–6 × 3 mm, apex acute or rounded, innermost tepals oblanceolate, *c.* 4 × 1.5 mm, apex rounded. Capsules 13–16 × *c.* 14 mm, glabrous, wings unequal, 2 wings shorter, *c.* 5 mm wide, 1 wing enlarged, concave, 12–15 mm wide, thinly fibrous, dehiscing between the locules and wings, pendent, pedicel stiff, 14–16 mm long.

ETYMOLOGY. *Vespi-* (wasp) + *propinqua* (neighbour), so-called because a large ground nest of aggressive 4 cm-long wasps was close to the rock face where the begonia grew and prevented us from collecting good flowering material of this species.

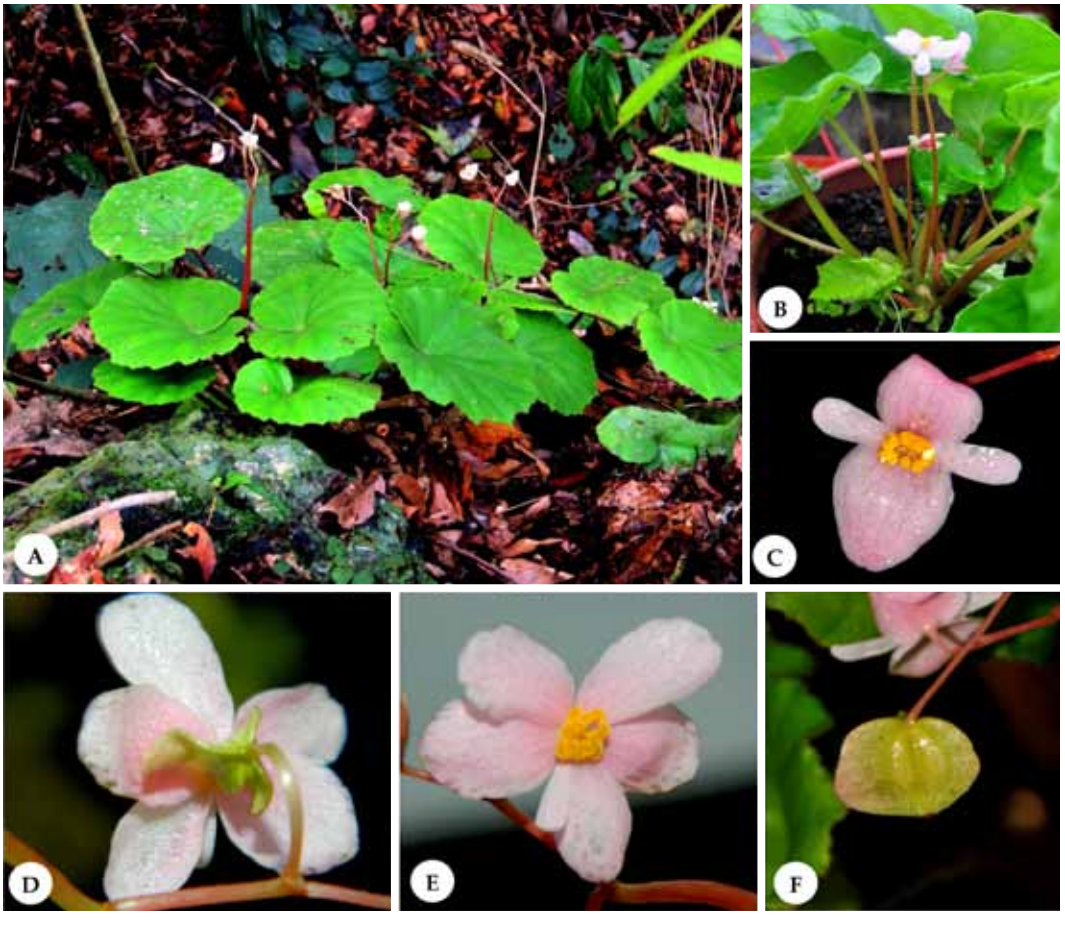

Fig. 12. *Begonia vespipropinqua*. **A.** Habit; **B.** Flowering plant; **C.** Male flower; **D** & **E.** Female flower; **F.** Fruit. Photo **A** from *SAN 156812* by Julia Sang; Photos **B–F** from *SAN 156812* (plant grown in the nursery) by Ubaldus Majawal.

ECOLOGY. Lowland mixed dipterocarp forest or submontane forest to 500–900 m elevation, on sandstone rocks in forest. Only one population was seen, where it was abundant and covered the vertical rock face 3–4 m high.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, East trail, *Campbell SAN 112139* (SAN); Gunung Danum, east ridge, *Argent et al. 1987158* (SAN); Field Centre, Forest behind Education Centre, *Chong et al. SAN 156812* (holotype SAN!).

INCOMPLETELY KNOWN

Begonia sp. 1 (Section *Petermannia*)

Erect begonia. Stems brown, wiry to 40 cm long, 4–6 mm thick, hispid with red brown hairs; internodes 1–1.5 cm long, thicker at nodes. Stipules pale green, lanceolate, *c*. 10 × 3 mm (when dry), margin toothed and hispid, apex attenuate into a tuft of hairs *c*. 5 mm long, persistent. Leaves alternate, close, not oblique, held horizontally; petiole densely hispid, thickened, 3–10 mm long; lamina red beneath when young, when mature only the veins are red, upper surface plain pale greyish green, thin (in life), matt, obovate, almost symmetric, 11.5–15.5 × 2.5–4.5 cm, broad side 2–2.5 cm wide, base unequal, basal lobes

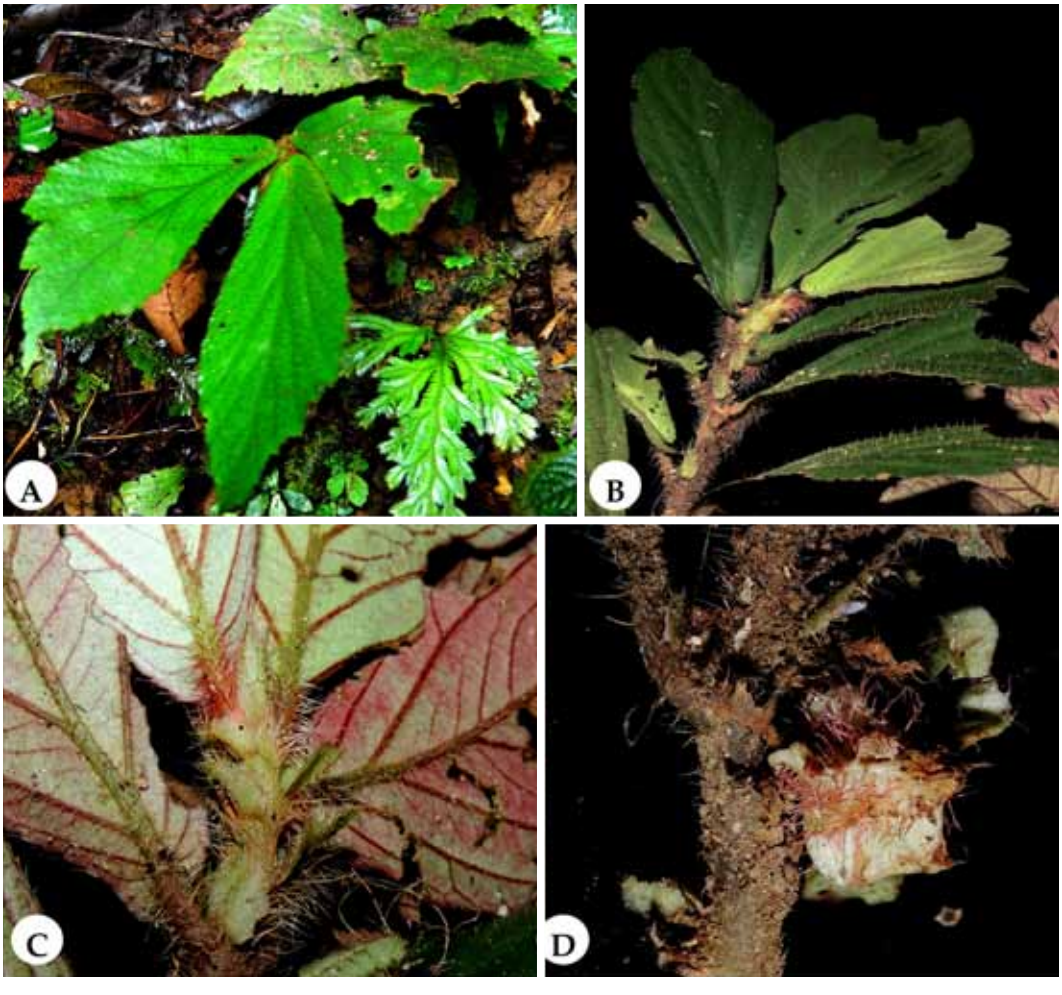

Fig. 13. *Begonia* sp. 1. **A.** Habit; **B.** Leafy twig; **C.** Leaf undersurface showing stipule; **D.** fruits. All photos from *SAN 156807* by Julia Sang.

scarcely developed, *c*. 0.2–0.3 cm long, bristly above, bristles white, beneath hairy only on the veins, hairs black, margin shallowly serrate, apex acuminate, acumen to 0.5–1 cm long; venation pinnate with *c*. 5 veins on each side of the midrib, branched once, impressed above, prominent beneath. Male flowers (buds) white with a touch of pink. Female flowers unknown. Fruits (immature) sessile, hirsute with red hairs, wings 3, pale green. **(Fig. 13)**

ECOLOGY. In mixed dipterocarp forest on steep banks above the small streams or on sandstone rocks on steep slopes at 313–350 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

CONSERVATION STATUS. Data Deficient because the taxonomic status of this species is not resolved.

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Conservation Area, Borneo Rainforest Lodge, Serpent trail, *Chong et al. SAN 157262* (SAN); Danum Valley Field Centre, West Trail, *Chong et al. SAN 156807* (SAN), *Madani SAN 113641* (SAN).

NOTES. Without flowers and a mature fruit, the specimens are insufficient to describe as a novel taxon. It belongs to the *Begonia pubescens* Ridley (1906: 254) group of begonias that are small wiry herbs with short petioles and non-oblique, almost symmetric laminas with pinnate venation, and short, few-flowered inflorescences.

DISCUSSION

All 15 species included in this account are endemic to Sabah and 12 are at present known only from the DVCA. Of the three recorded outside the DVCA, *Begonia gueritziana* is known to be widespread (Kiew, 2001), but for *B. gomantongensis* and *B. postarii*, both previously known from the Kinabatangan District, Danum is a new locality record. This illustrates how poorly collected Sabah is for begonias and that we can expect species to have wider geographic ranges than are presently known. Even so, the general situation for begonias in Borneo is that very few are widespread, the great majority are narrowly endemic (Kiew, 2001; Julia & Kiew, 2014).

To encounter 15 begonia species within three days indicates an extremely high level of biodiversity. One reason for this may be that the DVCA does not experience dry periods — annual rainfall averages about 1850 mm and no month has less than 100 mm (except occasionally in El Niño years). In addition, Hazebroek *et al*. (2012) reported that the soil in the DVCA has higher nutrient status and high water retaining capacity than elsewhere in

Sabah and this might be favourable for the growth of these understorey begonias. Another reason for high diversity is species pairs are closely similar in habit and occupy the same physical habitat, such as *B. danumensis-B. rotundibracteata* and *B. gomantongensis-B. inostegioides*. That they can co-exist without hybridising is likely due to their significantly different flowers that may result in reproductive isolation because they attract different pollinators (see *B. rotundibracteata* above).

The large proportion of new species is an indication of how little is known about the lowland *Begonia* flora in Sabah. Our three-day survey did not cover either the forests on ultramafic soils nor at the higher elevations where there is submontane forest. Indeed, in the SAN herbarium there are at least another 13 begonia taxa that we did not encounter and which, when complete material is available for them, can be described as new species.

In Borneo, about 85% of begonia species belong to section *Petermannia* (Klotzsch 1854: 124) A. de Candolle (1859: 128) (Julia & Kiew, 2014) and the proportion is even higher for Sabah (about 92%) where section *Reichenheimia* (Klotzsch 1855: 174) A. de Candolle (1864: 385) is hardly represented. While the majority of Danum species belong to section *Petermannia*, it was a surprise to discover that two of the new species belong to section *Baryandra* A. de Candolle (1859: 122). Previous to this study, only three Sabah species, *B. diwolii* Kiew (2001: 254), *B. gueritziana* and *B. subnummularifolia* Merr. (1926: 403) were recorded for this section (Rubite *et al.,* 2013) so the discovery of *B. bernadusii* and *B. vespipropinqua* significantly increases our knowledge of this section in Borneo. Like *B. gueritziana*, the new species are rhizomatous rosette plants. *Begonia diwolii* and *B. subnummularifolia* are creeping plants.

Apart from the species that is still incompletely known and so has been assessed as Data Deficient category, the remaining 14 species fall within the Least Concern category because the DVCA is a totally protected area being Class I Protection Forest.

Several of these species have potential as ornamental plants, most notably *B. ruthiae* and *B. prasinimarginata* for their variegated foliage. *Begonia taniana* with glossy deep green leaves and large pink flowers is another decorative species, while *B. postarii* produces attractive sprays of many small, deep red flowers.

CONCLUSION

The *Begonia* flora of Sabah is still largely unknown and because of relatively high biodiversity and narrow endemism, exploration of pristine rainforest on non-ultramafic soils is likely to result in the discovery of many new species. Indeed, Julia and Kiew (2014) estimate that Borneo, for which at present 126 species have been described, is likely to have a *Begonia* flora in excess of 600 species.

ACKNOWLEDGEMENTS

We would like to thank the Danum Valley Management Committee (DVMC) for granting the research permit and to Jikos Gidiman of Danum Valley Field Centre (DVFC), Sabah, Malaysia, for logistic support and for information pertaining to the surveyed sites. We are indebted to the various sections (Systematic Botany, Seed and Biotechnology) and Deputy Director (Research & Development), Dr Lee Ying Fah, of Forest Research Centre (FRC), Sandakan, for their strong support; to FRC research assistants, Markus Gumbilil and Martin Tuyok; and Raymond, DVFC forest ranger, who assisted in the field survey; and to Jumri Abd. Hamid (FRC) for providing the map. The curators of the SAN and KEP herbaria greatly facilitated our research by permitting us to examine specimens in their care and Mark J.E. Coode gave valuable advice on species epithets. We thank Mike Bernadus Bala Ola, who shared his detailed knowledge of Danum begonias, Dr Bill McDonald, who gave us the exact locality of *B. vespipropinqua* and warned us about the wasp nest, Ling Chea Yiing (Sarawak Forestry) for arranging the plates, and Ubaldus Majawal (SAN Herbarium) for providing the photos. The financial support from Tan Jiew Hoe, without which the research could not have been carried out, is gratefully acknowledged.

REFERENCES

De Candolle, A. (1859). *Begonia borneensis*. In: *Annals of Science Nat. Botany, Ser.* IV(11): 128.

De Candolle, A. (1864). *Prodromus Systematis Naturalis Regni Vegetabilis* (Begoniaceae). 15(1): 385.

Gibbs, L.S. (1914). A Contribution to the Flora and Plant Formations of Mount Kinabalu and the Highlands of British North Borneo. *Journal of the Linnean Society of London, Botany* 42: 1–240.

Hazebroek, H.P., Tengku Zainal Adlin & Waidi Sinun (2012). *Danum Valley: The Rain Forest*. Natural History Publications (Borneo), Kota Kinabalu, Malaysia. 568 p.

Hughes, M. & Pullan, M. (2007). Southeast Asian *Begonia* Database. Electronic publication accessible via www.rbge.org.uk.

IUCN (2001). *IUCN Red List Category and Criteria. Version 3.1*. IUCN Species Survival Commission. Gland, Switzerland and Cambridge, U.K.

Julia, S. & Kiew, R. (2014). Diversity of *Begonia* in Borneo — how many species are there? *Reinwardtia* 14(1): 233–236.

Kiew, R. (1998). Niche partitioning in limestone begonias in Sabah, Borneo, including two new species. *Gardens' Bulletin Singapore* 50: 161–169.

Kiew, R. (2001). The limestone Begonias of Sabah, Borneo — Flagship species for conservation. *Gardens' Bulletin Singapore* 53: 241–286.

Kiew, R. (2005). *Begonia of Peninsular Malaysia*. Natural History Publications (Borneo). 370 p.

Klotzsch, J.F. (1854). *Monatsberichte der Königlichen Preussische Akademie des Wissenschaften zu Berlin*: 124.

Klotzsch, J.F. (1855). *Abhandlungen der Königlichen Akademie der Wissenschaften in Berlin* '1854': 174.

Merrill, E.D. (1926). The flora of Banguey Island. Philippine Journal of Science 29: 341–427.

Ridley, H.N. (1906). Begonias of Borneo. *Journal of Straits Branch of the Royal Asiatic Society* 46: 246–261.

Rubite, R.R., Hughes, M., Alejandro, G.J.D. & Peng, C.-I. (2013). Recircumscription of *Begonia* section *Baryandra* (Begoniaceae): evidence from molecular data. *Botanical Studies* 54: 38.

Sands, M.J.S. (1990). Six new begonias from Sabah. *Kew Magazine* 7: 57–85.

Sands, M.J.S. (1997). Begoniaceae. In: Coode, M.J.E., Dransfield, J., Forman, L.L., Kirkup, D.W. & Idris, M.S. (eds.). *A Checklist of the Flowering Plants and Gymnosperms of Brunei Darulsalam*. Brunei Forest Department and The Royal Botanic Gardens, Kew. 433 p.

Stapf, O. (1894). On the Flora of Kinabalu: Begoniaceae. *Transaction of Linnean Society of London, Botany*, *Ser.* II (4): 164–167.

Stone, B.C.A. & Cockburn, P. (1976). Flora. *In*: Kiew, B.H. (ed.). *A Survey of the Proposed Sungai Danum National Park, Sabah*. An unpublished report submitted to the Sabah National Park Board. 39 p. (cited by Hazebroek *et al.,* 2012).